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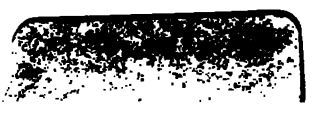

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TUBERCULOSIS IN INFANCY AND CHILDHOOD

TUBERCULOSIS IN INFANCY AND CHILDHOOD

ITS PATHOLOGY, PREVENTION, AND TREATMENT

By VARIOUS WRITERS

EDITED BY

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PREFACE

THE *British Journal of Tuberculosis* for July, 1907, formed a special number devoted to the consideration of "Tuberculosis in Infancy and Childhood," and contained signed articles by well-known authorities dealing with various aspects of the question. The issue attracted much attention and aroused widespread interest.

This same subject is now to receive prominent attention at the International Congress on Tuberculosis at Washington, U.S.A., in September and October next, a special section having been allotted to "Tuberculosis in Children."

As an expansion of our symposium in the *British Journal of Tuberculosis*, and also in view of the great gathering in America of the representatives of all nations, which must stimulate scientific inquiry, and develop new powers for practical service in the interest of infants and children throughout the world, this comprehensive and authoritative survey, in the form of a collection of studies, has been prepared.

As will be seen from the "List of Contributors," it is a work representative not only of the best English and American opinion, but also of those progressive nations who are giving particular attention to the protection of childhood and the solution of the tuberculosis problem.

Needless to say, each author has been given perfect freedom in the statement of his case, and must, of course, alone be held responsible for the opinions expressed.

As far as possible overlapping has been avoided, and where this is not entirely the case it will be seen that the subject has usually been approached from a different point of view. This, it is believed, will prove of distinct advantage.

The study of tuberculosis in early life, as well as the organization of ways and means to secure the prevention and arrest of the disease, are but in their beginnings.

WL 17

Throughout the work an attempt has been made to maintain a strictly scientific attitude of mind, and to avoid all unwarranted dogmatism. It is hoped and believed that what has been written will prove of permanent value in the elucidation of the problem. In order to render serious students of the subject all possible assistance, much attention has been given to the presentation of references likely to be of service in furthering investigations.

It is a pleasure to express my deep obligation to all who have so willingly and so ably co-operated in the production of this work. Its preparation in a comparatively short period of time would not have been possible without the loyal assistance of many confrères. No less than forty-one names appear in the "List of Contributors." To each and all of these unbounded thanks are due. By their kindness and forbearance an arduous task has been greatly lightened.

I am also indebted to many helpers, too numerous to mention individually, who have furthered the preparation of the work. My wife has assisted in the preparation of the Indexes, and in many other ways.

Lastly, to our publishers due acknowledgment must be made for their courtesy, consideration, and helpfulness in passing the work through the press.

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TUBERCULOSIS IN INFANCY AND CHILDHOOD

I.

THE PROBLEM STATED.

By the EDITOR.

Tuberculosis exacts heavy toll from infancy and childhood. Its prevalence seems to be much more extensive than is usually believed. Its manifestations are many and varied. Its results, even when a fatal issue is obviated, often entail irremediable crippling or lifelong delicacy. To it is due much individual suffering, domestic misery, and irreparable national loss. The most strenuous efforts of all available forces may well be devoted to the prevention and arrest of tuberculosis.

It is surprising that in the conduct of the anti-tuberculosis campaign measures for systematic study, organized prophylaxis, and adequate treatment of tuberculosis in early life should hitherto have received but little attention. This has undoubtedly been the case, particularly among English-speaking people.

In the United Kingdom and America comparatively little has been accomplished towards providing collective action for the safeguarding of children from tuberculosis. Means for the early recognition of the disease are all too meagre. Provision for affording suitable protective care for predisposed cases is scanty; and for children afflicted with active tuberculous lesions much difficulty is experienced in securing adequate rational hygienic management.

Although wide differences of opinion exist, even among those best qualified to serve as reliable leaders, concerning many of the pathological features of tuberculosis, it is becoming generally recognized that a not inconsiderable proportion of the heavy mortality and extensive crippling occurring in adult life from tuberculous disease is the outcome of an infection dating back to infancy and childhood. Tuberculosis

frequently lies dormant in the human soil for many years. The harvest of tuberculous disease in mature life is oftentimes dependent on a tuberculous seed-sowing in early days. This view, which is being supported by incontrovertible evidence, is concisely expressed by Dr. Hay :[1] "In the majority of instances tuberculosis is contracted in infancy or childhood, remains latent and unrevealed during school life, and only becomes evident in adolescence or early manhood."

Tuberculosis in early life is responsible for many far-reaching disabilities and not a few of life's long-postponed disasters.

It is the aim and object of this volume of collective studies on "Tuberculosis in Infancy and Childhood" to present in convenient and readily accessible form all available facts, theories, and suggestions bearing in any way on the problem.

The subject is one of extreme perplexity, and, in view of our incomplete knowledge relating to almost every phase of the question, the widest outlook is necessary. We are far from any approach to finality, and any attempt at dogmatism must necessarily be both unscientific and unjustifiable.

In the present volume, however, there are arrayed evidences and opinions from clinicians and pathologists, workers in many varied schools of thought and action, investigators in different lands, each and all having a right to be considered as experts on the particular phase of the subject with which they deal.

In the study of tuberculosis, it is only by co-operation and co-ordination that we can hope to secure reliable directing light. It is hoped and believed that the present work will be a means whereby our present knowledge may be focussed, and that it will afford indications of the path along which further advancement may be made.

This work offers a plea, and presents an argument, for a more serious and thorough study of the tuberculosis problem as met with in early life.

The Prevalence of Tuberculosis in Early Life.

During the twenty-five years which have elapsed since Koch's epoch-making discovery of the tubercle bacillus a vast amount of data has been accumulated relative to the frequency of the occurrence of tuberculosis in the human subject at all ages, and also in certain of the lower animals.

It seems clear that tuberculosis and a tendency thereto exist among the infants and children of civilized people to an extent not generally realized. The evidence of this is brought forward in the various essays composing this work. Facts have been collected from many lands,

[1] Hay, J.: "School and its Part in the Prevention of Tuberculosis," *Lancet*, May 9, 1908.

and are presented by observers capable of discussing the problem from widely differing viewpoints. In investigating a question so intricate and perplexing as that under consideration, it is necessary to collect evidence from as wide a field as possible. In the study of such a medico-sociological problem as tuberculosis international association is essential. This we have in a measure attained in the present work.

It will, however, not be out of place to indicate at the outset some of the more important facts bearing upon the prevalence of tuberculosis in infancy and childhood.

The published records of various pathologists seem to show that evidences of tuberculous infection are met with in about 40 per cent. of all children dying under fifteen years of age. Ante-natal tuberculosis is rare, and the disease is only exceptionally met with in infants under three months; but after this age it increases progressively, and is found in from 7 to 8 per cent. of all autopsies on children up to one year.[1]

Taking all children submitted to post-mortem examination under fifteen years of age, Harbitz[2] finds in Christiania tuberculous lesions in 42·5 per cent.; Hamburger and Sluka,[3] in Vienna, 40·0 per cent.; and Comby,[4] in Paris, 38·5 per cent. It is remarkable that, drawn from different countries and based upon the observations of different observers, the returns should be so similar.

Pottenger,[5] in his recent monograph on "Pulmonary Tuberculosis," devotes considerable attention to this question of the prevalence of tuberculosis in early life. He wisely urges that "in our endeavour to find methods to prevent tuberculosis, we must give the period of childhood much more attention than it has been wont to receive; for it is not only possible, but probable, that the seeds which ripen into full-fledged cases of tuberculosis in later life were in very many cases implanted in the tissues during the period of childhood, remaining there until a favourable time appeared for their activity." Statistics are referred to, and may well be quoted here: "Heubner[6] observed 844 children under three months of age without discovering a single case of tuberculosis; 218 between three months and six months, with 8 cases, or 3·6 per cent.; 93 between six and nine months, with 11 cases, or 11·8 per cent.; 75 from nine to twelve months, with 20 cases, or 26·6 per cent.; 45 from one to two years, with 14·2 per

[1] D'Espine, A.: "Fréquence Comparée de la Tuberculose chez l'Enfant et chez l'Adult." Rapports IIme Congrès International des Gouttes des Lait. Bruxelles, 1907.

[2] Harbitz: "Untersuchungen über Lokalisation der Tuberkulose," 1905.

[3] Hamburger and Sluka: *Jahrbuch f. Kinderheilkunde*, T. lxii., S. 517. 1905.

[4] Comby: *Presse Méd.*, p. 766, 1906.

[5] Pottenger, F. M.: "The Diagnosis and Treatment of Pulmonary Tuberculosis." London, 1908.

[6] Heubner: "Zur Verhütung der Tuberculose in Kindesalter." Berlin Congress, 1899.

cent.; and 367 from two to three years, with 13·4 per cent. In 36 sections made by Neuman[1] in children from birth to five months of age, tuberculosis was not found; in 33 cases from six to twelve months it was present 7 times, or in 21 per cent.; in 28 cases from one to two years it was present 10 times, or in 35·7 per cent. of the cases. Cornet analyzed the post-mortem records of the Berlin Pathological Institute from 1876 to 1891, as to the relative number of deaths from tuberculosis, with the following results: In 486 cases from birth to the end of the first month, tuberculosis was not present; in 33 cases from two to three months it was present twice, or in 6 per cent. of the cases; in 76 cases from three to six months, 8 times, or 10·5 per cent.; in 88 cases from six to nine months, 14 times, or 17 per cent.; in 65 cases from nine to twelve months, 18 times, or 27·7 per cent.; in 311 cases from one to two years, 83 times, or 26·7 per cent.; in 189 cases from two to three years, 56 times, or 29·6 per cent.; in 160 cases from three to four years, 15 times, or 31·8 per cent.; and in 134 cases from four to five years, 30 times, or in 22·4 per cent. Still[2] reports 769 post-mortems upon children under twelve years of age with tuberculosis present 269 times, or in 35 per cent. of the cases. Hand[3] reported to the Philadelphia Pathological Society statistics of post-mortems at the Children's Hospital for the past ten years. Of 332 autopsies made, 115, or 34·3 per cent., showed tuberculosis."

Naegeli[4] of Zurich has shown that "of the children between the ages of five and fourteen years who died, and on whom a post-mortem examination was made, 33 per cent. had some focus or other of tuberculous disease; similarly, between the ages of one and five years, 17 out of every 100 children going to necropsy were found to be infected."

Schlossmann[5] sums up the position thus: "It is by no means rare to find tuberculosis in children, and the nearer we approach puberty the oftener it is met with. The clinician must therefore look for tuberculosis in children of any age." The truth and wisdom of this pronouncement will be abundantly evidenced by the further statistics and experiences recorded in this volume.

It is necessary, however, to insist that mortality returns afford an altogether inadequate idea of the frequency with which tuberculous

[1] Neuman: Quoted by Jacob and Pannwitz: "Entstehung und Bekämpfung der Lungentuberculose," p. 198.

[2] Still: *British Medical Journal*, August 19, 1899.

[3] Hand: *Medical News*, p. 994, November 22, 1902.

[4] Quoted by Hay, J.: "School and its Part in the Prevention of Tuberculosis," *Lancet*, May 9, 1908, quoting from Méry, N.: "Rapports présentés au Congrès International de la Tuberculose," p. 298. Paris, 1905.

[5] Schlossmann, A.: Article on "Tuberculosis" in "The Diseases of Children." Edited by M. Pfaundler and A. Schlossmann. English Translation. Vol. ii., p. 569. Philadelphia and London, 1908.

processes occur in the living. Undoubtedly much of the delicacy, invalidism, and so-called minor ailments of children are dependent on or connected with unsuspected, unrecognized, or undefined tuberculous disease.

In England and Wales tuberculosis in its various forms continues answerable for a heavy mortality among children.

"The deaths from tuberculous meningitis are diminishing, but in 1902 still numbered nearly 6,000 (5,961). Of this total no fewer than 4,056, or 68 per cent., were those of children under the age of five years. Very much the same story is to be told of tuberculous peritonitis; the total (5,303) was much below the average for the previous ten years, but 3,815, or 72 per cent. of the deaths, were those of children under five years of age. There has also been a decrease in the number of deaths from tuberculosis of other organs and general tuberculosis, but, so far as can be judged, it has been less conspicuous. However this may be, the number is certainly large; 4,048 deaths were attributed to general tuberculosis, over half the victims being children under the age of five years; the deaths from tuberculosis of bones and joints and other specified organs numbered 1,413.

"The importance of tuberculosis as a cause of death in childhood may perhaps best be gauged from the fact that the death-rate it produced among children under five years of age in the year 1902 was 3·06 per 1,000 living, the death-rate from all causes being 49·07. In other words, of every 50 children who died, 3 at least died of tuberculous disease in one of its forms.

"But the death-rate is very far from giving a true criterion of the prevalence of tuberculosis in childhood. Tuberculous disease of the glands, especially of the glands of the neck, is very common in childhood, causing much ill-health and leaving ugly scars, but not often ending in death. Tuberculous disease of bones and joints is also far more common in children and adults, and many of its victims survive, permanently crippled."[1]

According to the late Sir William Broadbent, no fewer than 6,391 children under the age of five years died in London from tuberculous disease during the years 1901-1903, and of these, 2,894 were less than one year old.[2]

It is well to remember that there is need for much further investigation as to the influence of what may, perhaps, be best termed local,

[1] See article on "Tuberculosis" in Series "The Teaching of Hygiene in Schools," *British Medical Journal*, February 25, 1905.

[2] See article on "The Care of the Consumptive," by T. N. Kelynack, M.D., in "The Annual Charities Register and Digest." London, 1908. Also quoted by Thomson H. Hyslop: "Tuberculosis in Childhood," in "Pulmonary Phthisis." London, 1906.

social, geographical, or climatic conditions. This has been very clearly brought out by the researches of Dr. John Thomson in regard to abdominal tuberculosis.[1]

Bovaird[2] of New York has stated that in a single morning in the Edinburgh Children's Hospital he was shown more cases of abdominal tuberculosis than he had seen in New York during ten years of hospital and dispensary work.

The problem requires to be studied in relation to habits, customs, and all the multitudinous and varied elements which go to make up a child's environment. In China tuberculosis is said to be very prevalent, although cow's milk is seldom or never used. In Japan Kitasato has shown that "the rate of mortality from tuberculosis is the same among children as among adults, although tuberculosis does not occur in the cattle." Röhrdam shows that a like prevalence is met with in Greenland, "where cattle are not found at all."[3]

These and other like claims require to be thoroughly investigated, and thereby new light may be thrown upon the much-debated question of tuberculous infection.

Frequency of Tuberculosis among Children of School Age.

In view of the more or less compulsory attendance of children at school required by most civilized nations, school-going often being commenced at a very early age, and in consideration, also, of the extending practice of providing for medical inspection of all scholars, it is of the utmost importance that particular attention should be given to the question of the occurrence of tuberculosis among children of school age. This matter has received particular attention in this volume.

Recent investigations go far to show that tuberculosis is more widely prevalent in schools than is generally thought.[4]

In Great Britain reliable returns up to the present have not been available. From such statistics as are obtainable it would seem that from 0·5 to over 6·0 per cent. of children of school age present evidences of pulmonary tuberculosis. "At present medical officers vary widely in

[1] Thomson, John: "The Relative Prevalence of Abdominal Tuberculosis in Children in Great Britain and America," *British Journal of Tuberculosis*, July, 1907.

[2] Bovaird, D.: Transactions of the Second Annual Meeting of the American National Association for the Study and Prevention of Tuberculosis, p. 608. Lancaster, Pa., U.S.A., 1906.

[3] Quoted by Overland: "Human Tuberculosis and Cattle Tuberculosis," *Lancet*, August 8, 1908.

[4] See articles by Drs. Clement Dukes, J. E. Squire, Alfred Greenwood, William Robertson, and others, in the "Special Number on Children" of *British Journal of Tuberculosis*, July, 1907; also "Tuberculosis among School Children," by T. N. Kelynack, in Transactions of Second International Congress on School Hygiene, London, 1907; and in "Tuberculosis: Monatsschrift der Internationalen Vereinigung gegen die Tuberculose" Vol. vi. No. 12, December. Berlin, 1907.

their acceptance of signs and symptoms of 'revealed' intrathoracic tuberculosis. Much 'latent' tuberculosis passes unrecognized. 'Active' cases, undoubtedly, often gain admittance to a school and attend for a time. Of this, those of us who see children as out-patients have clear evidence."[1]

The late Professor Grancher estimated that among the scholars of the primary schools of Paris a characteristic predisposition to tuberculosis existed in 15 per cent.

The recognition of early tuberculosis in infancy and childhood is often extremely difficult. The most common seats for tuberculous involvement are undoubtedly the lymphatic glands of the abdomen and thorax. In children tuberculous affection of the lungs, bones and joints, and other parts of the body, appear to be nearly always secondary to disease of, or infection through, the lymphatic glands. Hence it is clear that no mere perfunctory examination hastily conducted can be expected to be other than misleading.

Active tuberculous lesions seem to be but rarely met with in higher and secondary schools, and are undoubtedly rare among the boys of the upper classes attending the old-established public schools. Statistics drawn from such sources cannot, however, be taken as affording any reliable guide as to the frequency of tuberculosis in children generally, for in these cases the family practitioner is almost invariably first consulted before a boy is sent to a public school. When in residence, more or less strict supervision is maintained, so that departures from health are early brought under medical observation, and the child, if seriously ill, returned to his home.

There is reason, however, to believe that among girls the case may be somewhat different. Certainly large numbers of girls predisposed to tuberculosis are submitted to the stress and strain of school life, with its exacting examinations and oftentimes lack of hygienic necessities, at an age when they ought rather to be carefully watched and wisely guided through those stages of physiological development when a latent tuberculosis is liable to be rekindled, and a predisposed soil is particularly prone to afford suitable lodgment for the tuberculous seed.

It is well to remember that teachers show a high mortality rate from tuberculosis. Many struggle on bravely for long before relinquishing their work. In this country and in America returns show that the mortality from consumption among teachers is considerably above the average.

Clearly the time is ripe for a thorough inquiry into the relationship of tuberculosis to all phases of school life.

[1] Kelynack, T. N.: "Children and the Anti-Tuberculosis Movement." "Bericht über den XIV. Internationalen Kongress für Hygiene und Demographie," Band iv., S. 253. Berlin, 1908.

Predisposition to Tuberculosis.

Much discussion has taken place, and great differences of opinion have been expressed, in regard to the question of predisposition to tuberculosis. By many the action of the tuberculous seed has been considered paramount. Recently, however, evidence coming from different sources and based on both clinical and pathological researches has very clearly shown that the character of the soil must be considered as of almost equal importance. The bearing of such a view on the application of prophylactic measures cannot but exercise far-reaching influence.

In this matter the researches of Professor Karl Pearson[1] have furnished suggestive conclusions.

Professor Arthur Thomson,[2] in his recent brilliant study of "Heredity," admirably expresses a view now gaining ground: "Besides the transmission of a constitutional vulnerability, besides the rare occurrence of ante-natal infection, besides the likelihood of household infection, besides the persistence of conditions of life which favour the disease—are there any other factors? There are probably two others. On the one hand, a seriously tubercular mother may be unable adequately to nourish her offspring before and after birth, and the ill-nourished offspring becomes the more readily the prey of disease. On the other hand, it seems likely that the bodily disturbances induced by tubercular disease in the parents may prejudicially affect the vigour of the germ-cells themselves, and thus lead to the production of inferior offspring."

As evidence of the proof of this view, the opinion of Sir William Whitla[3] may be quoted. He instances cases in which one young member after another of a large family in a small Irish homestead was compelled to push out abroad into different climates, and yet where each died of phthisis at middle age or beyond it. "In one remarkable case twelve members succumbed in this manner, though several of them had left home before their successors were born, and some lived to the age of forty." It is further suggested that "the disease may resemble a family disease, and not an hereditary one, in so far that both parents may survive their entire offspring and die at extreme old age, the predisposition being transmitted, as in the case of bleeders, by one or other, or both of them."

The practical bearing of all this must be evident. Many children are permitted to live under hygienic conditions which, instead of increasing their powers of resistance, tend rather to render them still more vulnerable to attack. Undoubtedly many tuberculously disposed

[1] Pearson, Karl: "A First Study of the Statistics of Pulmonary Tuberculosis." (Draper Company's Research Memoirs.) London, 1907.

[2] Thomson, J. A.: "Heredity." London, 1908.

[3] Whitla, Sir William: "A Manual of the Practice and Theory of Medicine." Vol. ii., p. 1299. London, 1908.

children are forced into schools ill-suited to their case. The day will come when we shall have learned to prevent tuberculosis by anticipating it.

Pottenger[1] has wisely insisted on the necessity of recognizing the important influence exercised by morbid states occurring early in life as predisposing to tuberculous infection: "The great majority of children are ill, more or less, during the first and second years of their lives. At this period, when they are least able to resist bacterial invaders, owing to the natural immaturity of their tissues, they have superimposed upon this natural weakness a vitality much reduced by disease. It would seem that it were more than coincidence that at the very time when these little ones are most prone to other disorders, the greatest number of them should succumb to tuberculosis. The most prevalent trouble at this time is connected with the digestive tract, which results in an inflammatory condition, with abrasions of the surface. Owing to poor ventilation and bad hygiene, and general mismanagement of the child at this time, it is apt to suffer, more or less, from catarrhal conditions of the upper air-passages, with abrasions of these surfaces as well. Some find those conditions present in both the respiratory and digestive tracts which make infection easy and certain."

As a practical measure, it would be well if the offspring of all tuberculous parents were dealt with as predisposed subjects. In many cases actual infection occurs very early. I have recently made a post-mortem examination on an infant under four months of age who came under my care when just over three months, presenting evidences of pulmonary tuberculosis. The father was said to be a consumptive. The mesenteric and bronchial glands were tuberculous, and the lungs studded with tubercles, but there was no generalized tuberculosis.

Of the upwards of 2,000 little folk in the National Children's Home and Orphanage, of which I am medical adviser, we find that something like 25 per cent. have to be considered as of tuberculous parentage. Such a return is hardly surprising when it is remembered that "more than one-third of all deaths at the ages 15 to 35 are from phthisis; and still larger numbers die at higher ages, though the proportionate mortality is smaller."[2]

It is well, also, not to forget that of the 1,200,000 new lives added annually to the population of the United Kingdom, one-fourth to one-third are born into conditions of want and squalor.[3] These, at least, are influences which strongly predispose to tuberculosis.

[1] Pottenger, F. M.: *New York Medical Journal*, March 21, 1903; and "The Diagnosis and Treatment of Pulmonary Tuberculosis." London, 1908.

[2] Niven, James: "Report on the Health of the City of Manchester for 1905," p. 16.

[3] Money, L. G. Chiozza: "Riches and Poverty." Third edition, p. 160. London, 1906.

Pathological Considerations.

In order to conduct a successful campaign against tuberculosis in all its forms, a sure basis of pathological truth is eminently desirable. Unfortunately, however, we are far from anything like agreement on fundamental points, and in the multiplicity of would-be scientific counsellors there is at present much confusion. This is much to be regretted. It is only by the coming of fuller knowledge regarding all ætiological factors that we can hope to provide a more perfect prophylaxis. We stand in need of further information relating to the channels of infection. Widely divergent opinions still prevail as to the relationship of tubercle bacilli of human, bovine, and other types.

The suggestive views of von Behring and the brilliant researches of Calmette, Guerin and Breton, and Sir William Whitla and Professor W. St. Clair Symmers and others, have done much to recast our views as to the commonest paths of tuberculous infection. As Sir William Whitla has it :[1] "Though we still are hardly justified in assuming that phthisis never occurs from the inhalation of dried sputum dust or from the breathing of the spray ejected in the act of coughing, it appears to be conclusively proven that, as forcibly put by Ravenal, the alimentary tract is a frequent portal of entry for the tubercle bacillus, which is able to pass through the intact mucous membrane of the bowel without producing any local lesion at the point of entrance."

Many hold that tuberculous milk is accountable for much of the tuberculosis in childhood. Others contend that infection by this medium is exceptional and unimportant; and it must be admitted that, even where there is little or no consumption of the milk of bovines, there tuberculosis prevails. Certainly tuberculous dust, when swallowed with the food or otherwise, appears capable of reaching the tissues through the intestinal walls. There is much evidence to show that tuberculosis in children is generally home-born and home-grown. Biermer[2] has designated tuberculosis "a bedroom disease." Many a child spends the greater part of the most important year of its life in an airless, dark, unwholesome dwelling. Even the offspring of the wealthy are too often kept cabined and confined in a nursery lacking in hygienic requisites. All these various points, and many others, receive full consideration in the essays which constitute this volume.

Tuberculosis, although sometimes appearing as a generalized affection, most frequently manifests itself as a chronic process, involving one or more regions of the body. It is therefore necessary to study it as a local disorder. This has been done in the present volume.

[1] Whitla, Sir William: Cavendish Lecture on "The Etiology of Pulmonary Tuberculosis," *Lancet*. July 18, 1908.

[2] See "Tuberculosis and Children," by A. Jacobi, M.D., in "A Handbook on the Prevention of Tuberculosis," p. 222. New York, 1903.

In a series of articles, each written by a well-known expert, practically every form of local tuberculous disease has been dealt with. The exigencies of space have prevented these from being absolutely exhaustive. They have been written principally from the practical standpoint which discusses morbid conditions in order that they may be prevented.

Of tuberculosis, more than any other disease, is it emphatically true, that " prevention is better than cure." But attempts at prevention, without well-substantiated knowledge regarding causation, are but little better than aimless gropings in the dark. It is the purpose of this volume to afford a reliable and scientific basis on which practical measures may be established for the prevention and arrest of all forms of tuberculosis occurring in infancy and childhood.

II.

THE ANTE-NATAL ASPECTS OF TUBERCULOSIS.

By JOHN W. BALLANTYNE,
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In considering the *ante-natal* aspects of tuberculosis, we shall be more likely to arrive at just conclusions regarding these matters if we leave out of account, at any rate for the present, the ideas which are commonly associated with that somewhat obscure and elusive subject, the *heredity* of tuberculosis. It is sufficient in the meantime to remember that an ante-natal or congenital malady or morbid state is not necessarily hereditary. A fœtus may be born into the world with the pustules of smallpox upon it, but we do not therefore call smallpox an hereditary disease; indeed, we explain it in quite another way.

Modern Views on the Ante-natal Manifestations of Tuberculosis.

That tuberculosis has an ante-natal aspect is again coming to be admitted even by those who most strongly emphasize its microbic origin and mode of dissemination; but this aspect of the disease has very different features now compared with those which it wore before the epoch-making discovery of the causal bacillus by Koch in 1881. Koch's discovery inflicted a destructive blow upon the current notions of the heredity of tuberculosis; but it merely modified without seriously altering the views which may reasonably be held regarding the ante-natal manifestations of the disease.

In order that we may gain some notion of the probable characters of ante-natal tuberculosis, we must have a clear conception of what ante-natal life is. It is the life of the organism before birth, and it passes through three periods: a *fœtal*, which is, roughly speaking, coextensive with the last seven months of pregnancy; an *embryonic*, which corresponds to the first two months of intra-uterine life with the exception of the first week; and a *germinal*, which occupies the first week of pregnancy, and extends back into the long antecedent epoch

during which the ovum was lying unimpregnated in the ovary, while the spermatozoon destined to fructify it was being prepared in the testicle. If there is such a thing as ante-natal tuberculosis, we should expect it to affect the new organism in all these three periods; but we should be prepared to find that its manifestations in each period would be characteristic of the period in question.

During the seven months of *fœtal* life the new organism has an existence not differing greatly from that enjoyed by the new-born infant. It grows rapidly, its nutrition is actively carried on, and the functions of respiration and excretion are performed partly by its own organs and partly by the placenta. There is very little organogenesis, or development properly so called, accomplished in this epoch of ante-natal life; that is almost entirely completed in the earlier embryonic stage. There are features, however, which differ from those of the life of the infant after birth: the respiration is a tissue one, and is carried out, not in the lungs, but in the placenta; the fœtus is shut off from external influences to a large extent; and its immediate environment is fluid (the liquor amnii), not aerial. The bearing of these peculiarities upon the characters of fœtal tuberculosis is manifest. The usual route of invasion of the organism by the bacillus of tubercle is here closed; no air enters the lungs during fœtal life, and no bacilli can therefore invade the lungs by that avenue and by this medium. We should therefore expect to find that pulmonary tuberculosis is either exceedingly rare or altogether unknown in the fœtus at birth even in cases in which the mother has suffered from phthisis in her pregnancy.

Congenital Pulmonary Tuberculosis.

This form of the disease is exceedingly rare. But if there are bacilli of tubercle in the blood of the mother, it is possible that they may enter the fœtus by the same route by which the oxygen for respiration and the food materials pass over—viz., by the placenta. It is not, however, to be expected that the placental tissues will be so easily traversed by organized things like microbes as by gases and simple proteids; and we are prepared to hear that the bacillary invasion of the fœtus *viâ* the placenta is not common.

Tuberculous Lesions in the Infant of a Tuberculous Mother.

This association is but rarely met with. If, however, the tubercle bacilli do burst through the placental barriers and invade the fœtal tissues, we should expect to find that the organs most markedly affected will be those lying in the way of the invading microbes, such as the liver, the heart, the brain, spleen, thymus gland, etc., but not the lungs, to which the fœtal heart sends very little blood. The examination of most of the recorded and clearly proven cases of fœtal tuber-

culosis shows a distribution of lesions very closely resembling that which theoretically we are led to look for. When we reflect, further, that the fœtal tissues are kept at a constant temperature slightly above that of the mother, and that they are normally germ-free, we are led to expect that, if tubercle bacilli do reach them, they will find them to be, so to say, good culture media, and they will readily multiply in them. This expectation, also, is borne out by some of the records of fœtal tuberculosis which are in literature, and by the statement made by one observer that the lesions in their severity resembled those of avian rather than human tuberculosis. So far the knowledge we possess of the peculiarities of fœtal physiology and of the placental economy have enabled us to predict where the probable lesions of ante-natal tuberculosis would be found, and with what rarity they would be encountered; but there are several circumstances connected with some of the recorded cases which have not yet been adequately explained.

Sometimes the fœtal tissues contain tubercle bacilli, and yet the organs show no tuberculous lesions. The placenta may be the seat of gross lesions (*e.g.*, hæmorrhages) capable of explaining the passage of microbes from mother to fœtus, but it is not always so affected, even in cases in which the fœtus has been found to show infection; and it has yet to be discovered what are the histological characters of the placenta which is capable of resisting the action of tubercle bacilli, or of preventing their transmission to the fœtus.

These problems, however, are not peculiar to fœtal tuberculosis; they emerge in connection with all the diseases which can be transmitted from mother to fœtus, including typhoid fever, syphilis, small-pox, sepsis, and pneumonia. Possibly some light may be thrown upon these matters by the application of Calmette's test for the ophthalmo-reaction to the new-born infants of mothers suffering from tuberculosis.

Tuberculous Toxæmia in Pre-natal Life.

It is possible that in some cases of tuberculosis in pregnancy the fœtus, while showing no tuberculous lesions, may yet have its tissues so weakened by toxinic products, sent over to it *viâ* the placenta or developed in it, that it is born in a feeble state, and easily succumbs to maladies attacking it during infancy, or remains delicate during life.

Tuberculous Involvement during Embryonic Development.

If we now pass to the *embryonic* period of ante-natal life, and inquire what effects follow upon the transmission to the embryo of tubercle bacilli or their products from the mother, we find ourselves in a region of speculation. It can hardly be doubted that, if the tubercle bacillus or its toxinic products exist in the maternal blood at this time, they may find their way through the decidual membranes to the embryo; but we cannot with any certainty predict what effect they will have upon

organs and tissues which are not yet formed, but only forming. We should expect that they will interfere with formation and cause malformations; and there is some evidence that the defects of development found in the children of tuberculous parents are due to infection during, not the fœtal, but the embryonic epoch of ante-natal life.

Para-tuberculosis of Ante-natal Life.

To such teratological results (*e.g.*, congenital cardiac malformations, webbed toes, hare-lip, ectopia of various organs, and even monstrosities) the name of heteromorphic tuberculous heredity has been given; but it seems more appropriate to call them *para-tuberculosis of ante-natal life.*

It still remains doubtful whether the arrival of the tubercle bacillus in the tissues of a developing organism, such as the embryo of a month old, can cause a truly tuberculous lesion at all. Perhaps these para-tuberculous manifestations are the only ones possible.

Tuberculous Involvement during Germinal Development.

Tuberculosis in *germinal* life is a still more obscure subject. May the ovum of a tuberculous woman contain a tubercle bacillus, and what influence will the microbe have upon the life and development of the ovum if it chance to be invaded also by the spermatozoon of a healthy man? May the semen of a tuberculous man carry tubercle bacilli into the uterus in the act of coitus, and is a bacillus-bearing spermatozoon capable of fertilizing a mature ovum? Will the impregnated ovum which has thus been invaded by tubercle bacilli or their toxinic products be able to grow into an embryo, and, if so, will it not almost of necessity be a malformed one? May a non-tuberculous mother be infected with tuberculosis by her husband in this indirect fashion, *viâ* the fœtus *in utero?* Attempts have been made to answer these questions by a reference to the phenomena of germinal syphilis; but the latter subject is itself so problematical that it would be as rational to appeal to the phenomena of germinal tuberculosis for the explanation of germinal syphilis. Now that the cause of syphilis, the spirochæte, is known, it may be possible to throw further light upon syphilis in the ovum and spermatozoon, and through it upon tuberculosis of these cells; but facts experimentally ascertained are not yet forthcoming.

General Conclusions.

The whole question of ante-natal tuberculosis has been more fully stated by the writer elsewhere.[1]

[1] Ballantyne, J. W.: "Manual of Ante-natal Pathology" (vol. i., pp. 206-217, Edinburgh, 1902), where also references to the literature are given. The work of G. Kuss, "De l'Hérédité Parasitaire de la Tuberculose Humaine" (Paris, 1898), is worthy of serious study; and Landouzy's "Rapport sur les Voies de Pénétration de la Tuberculose" (*Rev. de la Tuberculose*, S. ii., vol. iv., p. 357, 1907) deals in a suggestive fashion with some of the more obscure questions regarding conceptional and germinal tuberculosis. Robert Schlüter, in his short work "Die Fötale Tuberkulöse Infektion," 1902, gives a bibliography with 136 entries.

From the practical standpoint all that can safely be said is that the existence of tuberculosis in a pregnant woman is to a certain, but probably a small, extent an immediate danger to her unborn infant. In most cases it would seem that the placenta is an effective safeguard, and prevents the passage of the bacilli and their products; but, of course, disease of the placenta will diminish its protective action.

The less immediate dangers due to weakening of the embryonic and fœtal tissues, and their consequent proneness to disease (tuberculous or other), are probably real; but it is very difficult to obtain convincing evidence upon these matters. The whole question of germinal infection and its dangers has hardly yet emerged from the purely speculative phase.

III.

TUBERCULOSIS AND THE TUBERCULOUS DISPOSITION IN ORPHANS.

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From the earliest times attention has been given by thoughtful observers to the signs of faulty development in the child and the diseases which have appeared to be incident to mal-development. General appearances, including conformation of the organism, were appreciated and classified by the older writers. Hippocrates noted that the form of body peculiar to phthisical subjects "was the smooth, the whitish, that resembling the lentil," and "with the scapula having the appearance of wings." Two distinct types of conformation have been described—viz., (1) the "tuberculous," with bright eyes, oval face, thin skin, and long, thin bones; and (2) the "scrofulous," with a heavy figure, thick lips and hands, opaque skin, and large, thick bones. Other features have been described from time to time, all indicative, as it was thought, of the existence of predisposing factors in the development of tuberculosis. Among these are diminished respiratory capacity, a relatively small heart and narrow arteries, a pulmonary artery relatively wider than the aorta (Beneke), and relatively large-sized viscera. Many of the older writers believed that the cause of the disease was operable only upon those predisposed in the above-mentioned ways.

The Influence of Heredity.

The subject of congenital tuberculosis is an interesting and an important one. Though many cases have been reported, about twenty appear authentic. Among those who have reported such cases are Berti,[1] Auché and Chambrelent,[2] Merkel,[3] Schmorl and Birch-Hirsch-

[1] Berti: "Intorno alla possibilità di processi tisiogeni congeniti," *Bull. delle Sc. med. de Bologna*, p. 29. 1882.
[2] Auché and Chambrelent: "IV. Franz. Cgr. f. innere Med. Montpellier," *M. M. W.*, p. 616. 1898.
[3] Merkel: "Erster Bericht zur Sammelforschung," *Z. f. kl. M.*, Bd. viii., No. 6, p. 559. 1884.

feld,[1] Sabouraud,[2] Charrin,[3] Honl,[4] Lehmann,[5] Rindfleisch,[6] Bugge,[7] Hochsinger,[8] Heitz,[9] Jacobi,[10] and Keating. A theory advanced by Baumgarten is that the virus is directly transmitted, but remains latent, and does not develop until some time after birth. The apparent prevalence of the disease in the early months of life and the frequency of tuberculous disease of the bones and joints in infancy and childhood have led to this assumption. Baumgarten has suggested that the developing tissues of the young may inhibit the growth of tubercle bacilli. The view favouring the hereditary influence of tuberculosis is strongly supported by Baumgarten, while it is equally strongly refuted by many other investigators, chief among whom is Cornet. Suffice it to state that the majority of investigators at the present time believe that intra-uterine infection in tuberculosis is extremely rare, and that practically all cases are due to post-natal infection.

Modes of Entry of Tuberculous Infection.

In children the condition of the upper respiratory tract is of the utmost importance in facilitating the entrance into the system of tubercle bacilli. Acute and chronic catarrhal inflammations of these parts are frequently encountered. The tonsils are portals for the entry of many micro-organisms. Carious teeth also appear to furnish sites of inoculation. The frequency of enlargement of the cervical glands in childhood points rather conclusively to the fact that the mucous membranes of the mouth and throat are readily permeable by infectious agents. A large number of cases of cervical adenitis are undoubtedly tuberculous, although many are referable to other causes than tubercle. Osler[11] has observed in the post-mortem room enlargement of the cervical, axillary, and inguinal glands, without evidences of tuberculosis. In a few instances death had occurred subsequent to infectious

[1] Schmorl and Birch Hirschfeld: "Uebergang von Tuberkelbacillen aus dem mutterlichen Blut auf die Frucht," *Zeigler's Beitr.*, Bd. ix., p. 428.

[2] Sabouraud: "Tub. congénitale," *C. r. de la Soc. de Biol.*, p. 674. 1891.

[3] Charrin: "Tuberculose congénitale chez un Fœtus de 7½ Mois," *Lyon Méd.*, p. 295. 1873.

[4] Honl: "Bull. internat. de l'Acad. de Sciences de l'Emp. Franc. Jos. I." Prague, 1894.

[5] Lehmann: "Weitere Mittheilungen über Placentaltuberculose." *B. kl. W.*, 1894, Nos. 26 and 28; *C. f. G.*, Bd. xix., p. 886, 1895.

[6] Rindfleisch: "Verhandlungen der deutschen Naturforscher und Aerzte in Bremen, Part 2, p. 191. Leipzig: Vogel. 1891.

[7] Bugge: "Jens, Om medfödt Tuberculose, Festskrift i Anledning af Prof. Hjalmar Heibergs 25 aarsjubilaum," Christiania, p. 223; *C. f. B.*, 1895, Bd. xviii., p. 453.

[8] Hochsinger: "Syphilis congenita und Tuberculose," *W. M. Bl.*, Nos. 20 and 21. 1894.

[9] Heitz: *Revue de la Tuberculose*, p. 271. 1903.

[10] Jacobi: "Relat. des Premier Ans con. de Tuber. chez un Fœtus humain," Cgr. pour l'Étude de la Tub., p. 327. 1891.

[11] Osler: "American Text-book of Diseases of Children," pp. 270-302.

fevers, and in others the associated condition had been a chronic inflammation of the upper air-passages. Certain of the cervical glands may show enlargement not due to oral, tonsillar, or pharyngeal infection. The occipital, posterior auricular, and upper cervical groups may enlarge, owing to pediculosis capitis, eczema, herpes, and otorrhœa. Both Treves and Holt seem to believe that dissemination of the disease rarely occurs from tuberculous cervical glands, and Jacobi also lays emphasis upon the possible danger of such extension. Lesage and Pascal[1] have described cases of tuberculous adenitis in children in whom there was progressive involvement of the lymph glands, usually beginning in the inguinal region, then those of the axillary, and finally in the glands of the cervical and internal groups. The intestinal mucosa may offer a ready entrance to tubercle bacilli, allowing of easy and speedy transmission of the same to the mesenteric glands. Trauma may predispose to tuberculous invasion of other tissues, as often exemplified by Pott's disease of the spine and hip disease.

Frequency of Tuberculous Disease in Young Subjects.

The prevalence of tuberculosis in the young is well shown both by clinical and pathological records of hospitals and other institutions in the United States, Great Britain, and abroad. From three to fifteen years tuberculous disease is very frequent, and its manifestations in the glands and bones constitute a very considerable percentage of all cases in the out-patient departments of our hospitals, and in the special infirmaries, dispensaries, and other establishments for the treatment of diseases of children. The mortality, highest in the first year, sinks rapidly throughout childhood, to rise after puberty. The United States census report of 1870 shows that of 10,000 living, there die in the first year 18·5; in the second, 10·5; in the third, 5·9; from the third to the fifth, 2·9; from the fifth to the tenth, 2·0; from the tenth to the fifteenth, 3·3 per cent. The Kiel mortality statistics, collated by Heller,[2] show a similar condition. Müller found tuberculous lesions in 150 out of 500 autopsies upon children at the Munich Pathological Institute. From a collection of 2,230 autopsies, 753 children were found to have been tuberculous. At the New York Foundling Hospital, Northrup found the disease most prevalent between the ages of three and five years. Holt states that the disease is not so common in this country as it is in Europe. In 726 consecutive autopsies in the New York Infant Asylum tuberculosis was present in only 6 per cent., and of 319 consecutive autopsies in the Babies' Hospital, the disease

[1] Lesage and Pascal: Quoted by Osler (*loc. cit.*).

[2] Heller: Quoted by Osler (*loc. cit.*).

was found in 14 per cent. Statistics bear out the assertion that many cases of tuberculosis are sequelæ of the acute infectious fevers, especially measles, influenza, and pertussis. It has been assumed that there may have been a latent focus in the bronchial lymph glands. Northrup found thirteen cases in whom tuberculosis was limited to the bronchial glands, these cases having died of acute disease other than tuberculosis. In the orphan asylum at Nürnberg, with an average capacity of 100 children, many of them with a pronounced tuberculous taint, Stich[1] saw but a single case in eight years. At the orphan asylum in Munich, Schnitzlein[2] found that in 41 per cent. of the children both parents had died of tuberculosis, and in 43 per cent. either the father or the mother. In spite of this fact, he saw but two cases among 620 children. Cornet[3] states that the children hereditarily tainted are likely to remain healthy if they are brought up in an asylum, unless their new surroundings subject them to possible infection. He sent a circular with questions bearing upon this subject to fifty-one orphan asylums. Accurate answers were not in many instances forthcoming, owing to a lack of statistical data. It was determined that in a number of the asylums, with an average annual capacity of 515, only three cases of tuberculosis were recorded between the ages of five and twenty-one years. In these three cases symptoms appeared some time after their admission. In many other orphan asylums tuberculosis is encountered much more frequently. Cornet's deduction is that the true cause of the mortality lies not in hereditary taint, but rather in poor hygienic surroundings, such as are seen in the crowded asylums.

Temperature of Normal and Tuberculous Children.

Donald[4] has made a very interesting report relative to the temperatures of healthy children. Twenty were chosen in the Protestant Orphan Asylum of Detroit, and ranged in age from three to twelve years. Temperatures were taken at 8.30 a.m. and 6 p.m. for a period of fourteen days. Of the twenty-eight readings, 42 per cent. gave an average temperature of 99°, or over. In the majority of cases the higher readings occurred in the evenings. Of the 560 recorded temperatures, 2 per cent. were 100°, or over. The maximum was

[1] Stich: "Die Erblichkeit und Heilbarkeit der Tuberculose," *A. f. kl. M.*, Bd. xlii., p. 221. 1888.

[2] Schnitzlein: "Annalen des Städtischen Allgemeinen Krankenhaus zu München," Bd. v.

[3] Cornet: "Tuberculosis," in Nothnagel's "Encyclopædia of Practical Medicine," American edition, pp. 312-326.

[4] Donald: "Some Observations upon the Temperatures of Apparently Healthy Children: an Experimental Study," *Arch. Pediat.*, xviii., pp. 189-192. New York, 1901.

102°, and the minimum was 96·4°. There was a tendency toward a continued high temperature in 30 per cent. The evening temperature was found to be subnormal in a number of the children. The atmospheric temperature during the period of examination was practically constant. He noted the fact that after having played vigorously the temperature of the children was likely to be lower than at other times. None was sick at any time during the fourteen days, and none has developed any disease since that time. As is well recognized, irregularity and elevation of the temperature is often one of the earliest and most suggestive indications of a developing tuberculosis in children.

Personal Observations.

The writer[1] has made an examination of 122 boys at an orphan asylum in Philadelphia, for the purpose of determining, if possible, at what age pulmonary tuberculosis manifests itself in seemingly latent cases of lymphatic tuberculosis. An examination was made of the superficial lymphoid structures, the teeth, the eyes, etc., of each case, so as to determine whether boys of tuberculous or of non-tuberculous parentage manifest more abnormalities than others of vigorous parentage. Groups were made according to age, in order to determine at what time of youth or adolescence abnormality of these organs is most frequent, and what relationship age bears to tuberculosis. The temperature, the height, and the weight of each boy were taken. The index of corpulence (weight divided by the height expressed in feet) was employed, to compare the two groups of cases—those of non-tuberculous and those of tuberculous parentage. The latter group was subdivided into that of single and that of double tuberculous parentage. Questions were asked relative to the date of death of parent or parents, the duration of their tuberculosis, the length of time during which the child was exposed to infection, and his general condition up to the time of examination.

The work was undertaken on May 28, 1906, and completed on December 3, 1906. The order of examination was as follows: Name, age, occupation (if any), family history, previous personal history, date of admission to institution, present condition, general build, complexion, heart, lungs, cervical, occipital, posterior auricular, submaxillary, axillary, epitrochlear, and inguinal glands, tonsils, fauces, pharynx, teeth, pupils, irides, pulse, temperature, time of day, height, and weight. Three tables were made so that results might be clearly delineated:

[1] Cummins, W. Taylor: "Tuberculosis in Orphan Children." Third Annual Report of the Henry Phipps Institute, pp. 381-388. Philadelphia, 1907.

TABLE I.—ABNORMALITIES IN ALL BOYS EXAMINED.

	Parentage.				Total.	Per Cent.
	Tuberculous.	Per Cent.	Non-tuberculous.	Per Cent.		
Number of boys examined ...	59	48·3	63	51·7	122	—
Single tuberculous parentage	45	36·9	—	—	—	—
Double tuberculous parentage	14	11·4	—	—	—	—
Enlarged cervical glands (superficial and deep) ...	24	48·9	25	51·1	49	40·1
Enlarged cervical glands (superficial)	45	52·3	41	47·7	86	70·5
Enlarged cervical glands (deep)	28	43·0	37	57·0	65	53·2
Enlarged axillary glands ...	30	55·5	24	44·4	54	44·2
Enlarged inguinal glands ...	40	53·3	35	46·6	75	61·5
Enlarged cervical and axillary inguinal glands	21	63·6	12	36·4	33	27·0
Enlarged epitrochlear glands	2	33·3	4	66·6	6	4·9
,, tonsils	40	54·8	33	45·2	73	59·8
Mydriasis present	13	68·4	6	31·6	19	15·5
,, absent	45	45·4	54	54·6	99	81·2
Eye diseases (conjunctivitis, etc.)	1	25·0	3	75·0	4	3·3
Carious teeth	26	50·0	26	50·0	52	42·6
Temperatures:						
98·0° to 98·6°	4	26·6	11	73·3	15	12·3
98·7° ,, 99·6°	45	50·5	44	49·5	89	72·9
99·7° ,, 100·6°	10	71·4	4	28·6	14	11·5
100·7° ,, 101·6°	—	—	3	—	3	2·5
101·7° ,, 102·6°	—	—	1	—	1	0·8
Number of boys weighed ...	48	46·1	56	53·9	104	—
Index of corpulence (average)	16·07		16·56		—	—

Fifty-nine boys, or 48·3 per cent., were of tuberculous parentage. Of these, forty-five were of single and fourteen were of double tuberculous parentage. Rather an arbitrary division of sizes was made in order to define clearly the enlarged and unenlarged glands. Those having the size of a split pea or less were classed as unenlarged glands. Enlargement of the superficial cervical, the axillary, and the inguinal glands was more frequent among those of tuberculous parentage; likewise was the distribution of enlarged tonsils. Sixty per cent. of the cases showed tonsillar enlargement. Twelve per cent. of the cases gave a normal temperature (98° to 98·6°), and 74 per cent. of these had neither parent tuberculous. High temperatures were more frequent among those of tuberculous parentage. The index of corpulence was somewhat lower in the members of the latter group.

TABLE II.—ABNORMALITIES IN BOYS OF TUBERCULOUS PARENTAGE.

	Tuberculous Parentage.		
	Single.	Double.	Total.
Enlarged cervical glands (superficial and deep)	20	4	24
,, ,, ,, (superficial)	35	10	45
,, ,, ,, (deep)	23	5	28
,, axillary glands	22	8	30
,, inguinal glands	33	7	40
,, cervical, axillary, and inguinal glands ...	17	4	21
,, tonsils	33	7	40
Mydriasis	8	5	13
Carious teeth	21	5	26
Temperatures:			
98·0° to 98·6°	3	1	4
98·7° ,, 99·6°	33	12	45
99·7° ,, 100·6°	9	1	10
100·7° ,, 101·6°	—	—	—
101·7° ,, 102·6°	—	—	—
Index of corpulence (average)	16	16·2	—

TABLE III.—RELATION OF AGE TO ABNORMALITIES.

	8 to 10 Years.			11 to 13 Years.			14 to 16 Years.			17 Years.		
	S.	D.	N.-T.	S.	D.	N.-T.	S	D.	N.-T	S.	D.	N.-T.
Enlarged cervical glands (superficial and deep)	3	—	1	13	3	13	4	1	11	—	—	—
Enlarged cervical glands (superficial)	3	—	1	23	8	21	8	2	18	1	—	1
Enlarged cervical glands (deep)	4	—	2	14	4	23	4	1	12	1	—	—
Enlarged axillary glands	4	—	3	16	5	15	2	2	6	—	1	—
Enlarged inguinal glands	3	—	3	21	4	20	9	2	12	—	1	—
Enlarged cervical, axillary, and inguinal glands ...	3	—	1	12	4	7	2	—	4	—	—	—
Enlarged tonsils	4	—	2	22	4	22	6	3	9	1	—	—
Mydriasis	—	—	—	5	4	4	3	1	2	—	—	—
Temperatures:												
98·0° to 98·6° ...	—	—	1	1	1	4	—	—	6	2	—	—
98·7° ,, 99·6° ...	1	—	3	22	8	28	10	3	12	—	1	1
99·7° ,, 100·6°	3	—	—	4	1	3	2	—	1	—	—	—
100·7° ,, 101·6° ...	—	—	—	—	—	2	—	—	1	—	—	—
101·7° ,, 102·6° ..	—	—	—	—	1	—	—	—	—	—	—	—
Number of boys examined (total)	4	—	4	27	10	38	12	3	20	2	1	1

S. stands for single tuberculous parentage; D. for double tuberculous parentage; N.-T. for non-tuberculous parentage.

With the exception of the axillary glands, enlargement of the lymph glands appeared more frequently among the class of single tuberculous parentage. Temperatures of 98·7° to 99·6° were found to be

more common among those who had both parents tuberculous, while temperatures of 99·7° to 100·6° among those with one parent tuberculous. The index of corpulence was somewhat lower in the latter group than in the former.

The largest number of cases of enlarged lymph glands was found between the ages of eight and ten years, with the exception of the superficial cervical group, which were more frequently enlarged in those boys between fourteen and sixteen years. In six cases the glands at times became enlarged and tender. Two of these were of single tuberculous parentage, one was of double, and three were of non-tuberculous parentage. Usually but one or two glands were involved in this way in any one case. There were six cases of enlarged occipital and one case of enlarged posterior auricular glands, and pediculosis capitis was probably responsible for the condition. Congestion of the fauces, tonsils, or pharynx was seen in thirteen cases, and the average temperature of these was 99·4°. Eight of them were of tuberculous parentage. In regard to complexion, the boys were divided into three groups—viz., dark, light, and red. Of dark complexion, there were 51, and 20 of these were of tuberculous parentage; of light complexion, there were 41, and 21 of these were of tuberculous parentage; of red or sandy complexion, there were 19, and 9 of these were of similar parentage. (Eleven cases were unrecorded.)

One boy was found to be suffering with pulmonary tuberculosis. His history was as follows: H. S., aged thirteen years. Occupation, none. Mother died of pulmonary tuberculosis, and boy was exposed to infection for two years. Personal history: Cough for two years; yellow sputum, with occasional blood; chest pains; loss of appetite and weight. Physical examination: Infiltration of the right apex; tonsils much enlarged and congested; moderate enlargement of all the lymph glands. Temperature, 99·4° at 9.0 p.m. Sputum showed no tubercle bacilli upon three examinations.

One case of probable tuberculosis of the cervical glands was observed. Several of these glands had already been removed, and there was moderate enlargement of those of other groups. (No histological examination had been made of the ablated glands, so that a diagnosis of the condition was not proven.) Both parents were tuberculous, and the father was tuberculous at the time of conception. (Since these records were made the boy has developed pulmonary involvement, and he is at present in a sanatorium.) Another child, of non-tuberculous parents, was epileptic. Six exhibited typical phthisinoid chests, four of these being of single tuberculous parentage and two of non-tuberculous parentage. Three rachitic chests were observed, and all were in boys of non-tuberculous parentage. Five boys were born of parents of whom one had tuberculosis at the time

of conception or during pregnancy. In three of these the father was tuberculous, and in one the mother died of tuberculosis two weeks after the birth of the child. Of these five cases the heart and lungs showed no abnormality; the physiques were good, except for one phthisinoid chest. One had a splendid development. Temperatures ranged from 98·4° to 99·8°. The index of corpulence was somewhat below the average of all the boys of tuberculous parentage.

Owing to the small number of cases examined the results are not conclusive, but at least a few points have been brought forth that are suggestive.

Practical Considerations.

The conclusions which may be drawn from Friedmann's[1] study are: "In young children tuberculous invasion of the tonsils is of considerable importance, especially as to cervical glandular tuberculosis, and the infection is introduced in food. In the end we again are brought up before the fact that prevention is more important than efforts at cure." Osler[2] says that "the study of the tuberculosis problem in the foundling asylums and children's hospitals of the country would not only be interesting in itself, but directly beneficial in improving the sanitary surroundings of the institutions. Attached to every foundling asylum or children's hospital there should be a paid pathologist, who should report yearly to the Board of Managers and to the Medical Board on the prevalence of tuberculosis in the institution. He better than anyone else would be in a position to furnish data upon which important sanitary changes might be based."

Carr[3] admirably summarizes the situation: "That tuberculous disease in children commences usually in the lymph glands, the liability being at the maximum during infancy and early childhood, and rapidly decreasing in later childhood; that glandular disease may often exist alone and quite unsuspected; that in very many cases, doubtless, it is impossible of diagnosis; that in dealing with obscure febrile conditions in children it is well to realize the very definite possibility of the symptoms being due to caseation in glands, and make every effort to discover their existence, and to use appropriate medicinal and climatic treatment. But, after all, by far the most important treatment is the prophylactic. We may aim at excluding sources of infection in milk, meat-juice, etc., and, still more important, in the air; but, do what we can, under present circumstances bacilli must obtain access—they are probably too omnipresent to be excluded. We must, therefore, increase the resistant powers of

[1] Friedmann: *Ziegler's Beitrage*, xxviii., 66-133. 1900.
[2] Osler: "Notes on Tuberculosis in Children," *Arch. Pediat.*, x., p. 979. 1893.
[3] Carr: "The Starting-points of Tuberculous Disease in Children," *Lancet*, London, i., 1177-1181, 1894.

the system to their entry, above all, by keeping the mucous membranes healthy. Whether the glands get infected directly through the lymphatic channels or indirectly through the blood-stream, the organisms must in every case have passed through a mucous membrane, and through a healthy one they probably cannot penetrate. We have, therefore, to try to prevent gastro-intestinal and respiratory catarrhs, and especially to avoid their becoming chronic; to deal promptly with, and, if possible, to prevent, rickets, the great cause of such catarrhs in childhood; and to take especial care of children during convalescence from measles, whooping-cough, and other acute specific diseases."

At the last International Congress on Tuberculosis evidence went far to show that tuberculosis is implanted in the child at home. Many consider that tuberculosis in the adult has had its inception in infancy or childhood with a long latent period intervening.

National Measures.

For the provision and supervision of the tuberculous young France leads the world, and her efforts have been expended mainly through the establishment of marine health-stations. Germany is rapidly moving forward in this work by the founding of forest and other hygienic schools. England and America have as yet done little toward furthering this movement. Sir J. Grant says that "the prospect of long life depends greatly upon the manner in which life has been cared for and protected in the stage of childhood. In this period the very corner-stones of future strength and constitutional development are placed, so as to build up and construct tissues possessing the very elements of vitality."[1]

[1] Grant: "Our Children and Tuberculosis," *Canada Lancet*, Toronto, xxxix., pp. 783-786, 1905-06; also *Montreal Medical Journal*, xxxvi., pp. 331-334, 1906.

IV.

THE MILK PROBLEM AND TUBERCULOSIS IN INFANCY AND CHILDHOOD.

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The best of causes may be weakened either by exaggeration or understatement; and in attempting to estimate the dangers children incur of acquiring tuberculosis through the agency of milk, we are confronted by the extremist view on the one hand, and on the other by the assertion that milk-borne infection is so rare as to be negligible in comparison with other forms. This communication is an attempt to answer two questions: First, What are the risks? and, second, How are they to be met?

The Relationship of Bovine and Human Tuberculosis.

Until the year 1901, when Koch asserted that human and bovine tuberculosis were not reciprocally infective, the identity of the two diseases was scarcely questioned. Had his contention that bovine tuberculosis is rarely, if ever, transmitted to man been substantiated, it would have minimized, if not abolished, the need for considering milk as a possible vehicle of infection. But the evidence is all in the other direction. The findings of the Royal Commission[1] alone conclusively demonstrate that, notwithstanding remarkable differences between bacilli from bovine and human sources, tuberculosis may, especially in children, be caused by the bovine bacillus. Whatever the ultimate relationship of the bovine and human types of organism prove to be, it is a very striking fact that a large proportion of cases of tuberculosis primarily originating in the abdominal cavity is due to tubercle bacilli of bovine source.

[1] "Second Interim Report of the Royal Commission on Tuberculosis (Human and Bovine)." London, 1907.

Frequency of Tuberculosis originating from the Alimentary Canal.

So far as this country is concerned, about one-fourth of all fatal cases of tuberculosis occurring in childhood are primarily abdominal. Shennan's[1] series of cases showed 28·1 per cent.; Still's,[2] 29·1 per cent.; Carr's,[3] 16·7 per cent.; Leonard Guthrie's,[4] 24·6 per cent.[5] Figures such as these make it quite apparent that at least three-quarters of the fatal tuberculosis in childhood arises outside the intestine—usually, of course, through the respiratory tract. It is much less evident what part may justly be assigned to milk in the production of the other quarter.

Is all Abdominal Tubercle due to the Ingestion of Infected Milk?

It is temptingly simple to assume that tubercle conveyed by milk causes abdominal infection, while that acquired by inhalation mainly invades the lungs; but the facts do not warrant so general a statement. The age-distribution of abdominal tuberculosis scarcely supports it. According to the figures of Shennan and Still,[6] based on cases occurring up to the twelfth year, the disease is rare during the first twelve months, when milk is most used (6 to 8 per cent.), rises rapidly to 25 to 30 per cent. during the second year, is nearly as common in the third and fourth years (16 to 28 per cent.), while the remaining cases distribute themselves fairly uniformly over the fifth to the twelfth years. We must not, on the other hand, lay too much stress on the relative infrequency of abdominal tuberculosis during the first year, because, after all, a not inconsiderable proportion of infants are fed otherwise than on raw cow's milk at this period, and there is, probably, a rather widespread tendency to discontinue sterilization as soon as babyhood has passed, so that the risks of infection are then enhanced. It may also be urged that the seeds of a chronic disease, though sown in infancy, do not at once produce fruit. While this is to some extent true, we know that in children under a year tuberculosis is prone to run a fairly rapid course.

Again, as Leonard Guthrie insists, tubercle bacilli may be inhaled

[1] Shennan: "Tuberculosis in Children," Edinburgh Hospital Reports, vol. vi., p. 130. 1900.

[2] Still: "Tuberculosis in Childhood," *Practitioner*, July, 1901.

[3] Carr: "The Starting-points of Tuberculous Disease in Children," Trans. Med. Soc. Lond., vol. xvii., p. 288. 1894.

[4] Guthrie, L.: "The Distribution and Origin of Tuberculosis in Children," *Lancet*, vol. i., p. 286. 1899.

[5] The above figures are in striking contrast to what obtains in Germany. Koch (1901) had seen only two cases of primary abdominal tuberculosis; Biedert, in 3,104 post-mortems on tuberculous children, only ten. Hamburger ("Festschrift enthaltend Arbeiten über Tuberkulose," p. 34, Wien, 1907) records 335 autopsies on children without a single case.

[6] Still: "Abdominal Tuberculosis in Children," *Clinical Journal*, December 11, 1901.

into the mouth and subsequently swallowed, the primary abdominal infection thus arising independently of food.

Most of the foregoing data rest on the examination of fatal cases of tuberculosis, and the fact that there is probably a greater tendency towards cure in abdominal tubercle than in most other varieties suggests that the figures require some correction in this respect. In order, however, to settle these questions definitely, we must look to inquiries in a quite different direction. It is not possible to rely exclusively on the age of the lesion as proof of the point of entry. All the lymph streams ultimately converge to the thorax; and Professor Sidney Martin has shown that in successful feeding experiments on pigs the focus of disease produced may be remote from the abdominal cavity, indicating that an ingestion tuberculosis need not necessarily show itself locally. A solution of the problem is more likely to be given by the bacteriologist, who alone can ascertain in what proportion of cases of tuberculosis the bovine, and in what proportion the human, strain of bacillus is present. The Royal Commission investigated this point in sixty-four cases: fourteen gave the bovine and forty the human virus. Bovine bacilli were found in ten cases of primary abdominal tuberculosis, once in sputum, and thrice in tuberculous glands. Human bacilli were found in eight cases of abdominal tubercle, in ten of pulmonary phthisis, in nine of osseous tubercle, and a number of other cases of affection of various organs. Beitske,[1] in twenty-five post-mortems on Berlin children, found the bovine virus twice only—once in a case of phthisis, and once in primary abdominal tuberculosis. The latter was the sole instance of that lesion in his series.

After making all allowances, and accepting the fact that abdominal tubercle is neither due to milk infection alone nor the sole form of tubercle that milk infection may cause, I think we are amply justified in conjecturing that tuberculous milk is responsible for a quarter, more or less, of the tuberculosis of childhood.

Prevalence of Tubercle-Infected Milk.

Milk may be contaminated by tubercle—(1) through being handled by a consumptive person or exposed to infected surroundings; (2) it may be contaminated in the milking-shed by the dried fæces and expectoration of tuberculous cows; (3) it may (though this is probably rare) contain bacilli if the cow yielding it be tuberculous, although the udder is healthy; and (4) it will almost assuredly be infective if drawn from a tuberculous udder. This, of course, far transcends in importance all other sources of contagion, but that the others do exist ought not to be entirely disregarded.

[1] Beitske: "Ueber die Infektion des Menschen mit Rindertuberkulose," *Virchow's Archiv*, Bd. cxc., Beiheft, December 7, 1907.

The following table, which has been compiled from figures for which I am indebted to the courtesy of the medical officers and sanitary authorities of the respective towns, gives an idea of the prevalence of tubercle in random samples of the mixed milk of commerce:

TABLE INDICATING THE ESTIMATED PREVALENCE OF TUBERCLE BACILLI IN SAMPLES OF THE MIXED MILK OF COMMERCE.

Town.	Year.	Number of Samples.	Percentage of Tubercle.
Manchester	1901–6	3,035	7·8
Sheffield	1902–6	366	13·05
Leeds	1904–6	160	6·2
Liverpool (town milk)	1906–7	1,972	1·5
„ (country milk)... ...	1906–7	2,725	6·5
Birmingham (town milk)... ...	1906–7	5	0
„ (country milk) ...	1906–7	175	14
Glasgow (country milk)	1907	77	4
Aberdeen	1904–5	27	7·4[1]
Edinburgh (town milk)	1906	21	0[2]
„ (country milk) ...	1906	62	0[2]
London	1907	—	8·3[3]

From these figures it is evident that everybody who habitually consumes raw milk must from time to time ingest living tubercle bacilli, and yet, after all, only a comparatively small number of individuals thereby contract tuberculosis. This is in harmony with the experimental results of the Royal Commission, which prove that it is much more difficult to cause active tuberculosis by feeding than by inoculation. The question of dosage, too, is important. It has been clearly proved that there is a minimum limit to the number of bacilli required to produce active tuberculosis. On the other hand, bovine bacilli are at least as virulent as the human strain, and they are even more highly pathogenic to some non-bovine animals—*e.g.*, anthropoid apes—than to bovines. Probably, therefore, the reason why tuberculous milk is so often innocuous is that the number of bacilli it contains is small.

How are the Risks of Infection to be Met?

To answer this question satisfactorily we must discuss—(1) *Legislative*, (2) *Commercial*, and (3) *Domestic* measures and methods of control.[4]

[1] Two cases, one being doubtful.

[2] No inoculation experiments. Deposit and centrifuged sediment of 1 litre milk examined in each case for acid-fast bacilli, with negative results.

[3] *Sanitary Record*, April 9, 1908.

[4] For further particulars see Swithinbank and Newman: "Bacteriology of Milk." London, 1903.

Legislative Control of the Milk-Supply.

Legislative control of the milk traffic is based on the "Dairies, Cow-sheds, and Milk-shops Orders" of 1885, issued by the Privy Council (and subsequently vested in the Local Government Board) in virtue of powers conferred by the Contagious Diseases (Animals) Act of 1878. The Order, which extends to Great Britain, but not Ireland, deals with—(1) the registration of milk dealers; (2) the sanitation of dairy premises with reference to health of cattle, cleanliness of utensils, and protection of milk from contamination; (3) infectious disease among persons handling milk; (4) sleeping apartments and water-closets in relation to dairies; and (5) certain specified diseases of cattle—viz., cattle plague, foot-and-mouth disease, anthrax and pleuro-pneumonia. The milk of diseased cows shall not—(*a*) be mixed with other milk, (*b*) be used for human food, or (*c*) be fed to other animals without being boiled. In 1899 "disease of the udder certified by a veterinary surgeon to be tuberculous" was brought under the operation of Section 5 (*a*) and (*b*), but not under (*c*).

It rests with local authorities to enforce this Order, which, moreover, contains a section empowering them to issue local regulations on the spirit of the Act for the inspection of cattle, etc., the object being to make the application of the Order effective. This section is, however, permissive, not compulsory. By the Public Health Act, 1890, a medical officer can prohibit the supply to his district of milk which *is causing* infectious disease, whether such milk be derived from sources inside or outside his own district.

In addition to this general legislation, a number of municipalities have further powers derived from local Acts. Manchester and Glasgow have been pioneers in this, and the general effect of such local legislation is to give increased powers of inspection, and to extend them to all localities whence the city gets milk; to prohibit the supply of tuberculous milk; to isolate cattle suffering from mammary tuberculosis; and to make notification of suspected cases of that disorder compulsory. The last clause is said to be practically inoperative.

In Scotland the Public Health Act, 1897, provides for the Medical Officer of Health taking steps to check the supply of a milk which *is likely to cause* infectious disease, wherever such milk is derived from. This marks an advance on the English Act aforesaid, in so far as it is unnecessary to wait until the mischief has actually come to pass, and in that the prohibition to supply is absolute, not merely local.

On the general subject of legislative control I would make the following comments:

1. The outstanding defect of existing legislation is that it is so largely optional. Its adoption ought to be universal and compulsory.

Its provisions are far-reaching, and the benefits which accrue from their stringent enforcement are sufficiently plain if we compare the proportion of tubercle in town and country milk—*e.g.*, Liverpool (see Table)—inspection being, of course, much more thorough in urban than in rural dairies.

2. The milk trade can only be effectively dealt with by being supervised as a whole. Cities obtain their supplies from remote quarters; hence they require powers extending beyond their own boundaries. But if all local authorities were compelled to act inspection would be more thoroughly performed, because carried out by men on the spot, armed with local knowledge, than when performed by the officials of a town, possibly many miles distant.

3. Under the Scottish Public Health Act, 1897, the sale of infected milk can be absolutely prohibited, either inside or outside of the district where it is produced. The Scottish Local Government Board has ruled that pulmonary phthisis is an infectious disease within the meaning of this Act, and presumably tuberculous milk would also be covered by it. In any case, such an anomaly as that of a dairyman who has been prohibited from purveying milk to a neighbouring town continuing to supply it to a district adjoining ought to be impossible.

4. The *source of the mischief* should be grappled with by steps being taken to diminish the amount of tuberculosis among cattle. In the above legislation the points bearing on this very large question are not numerous. Isolation should be extended to all forms of tuberculosis, not only to that of the udder; and Section 5 (*c*) above should apply to tuberculous milk, which ought not to be fed to animals without being boiled.

5. Such questions as compensation for loss incurred through compulsory isolation or slaughter of animals, through temporary disturbance of business contracts caused by the operation of restrictive clauses; the cost of providing free tuberculin-testing, and others, have to be faced. It must, however, be remembered that the State has not hesitated to impose analogous obligations on other employments without granting compensation, and that these obligations have been met by insurance.

6. To prevent the infection of milk by tubercle from extramammary sources would involve—(*a*) compulsory notification of phthisis with the prohibition of persons suffering from that disease from engaging in the milk trade; (*b*) much greater care than is now taken to keep milk in covered vessels, and the isolation of all tuberculous cattle; (*c*) the carrying out of milking outside cow-houses, in special milking-sheds.

Commercial Control of the Milk-Supply.

Every dairyman nowadays knows, or ought to know, perfectly well how his business should be conducted from a hygienic point of view, and the precautions taken by some of the large dairy companies[1] are much more stringent than any the law contemplates. But the average dairyman is only human, and will give his customers no more than they ask. When once the public are sufficiently instructed to refuse milk produced as seven-eighths of the milk used is produced at present, commercial enterprise will meet their demands. The small purveyor of milk might, and probably would, suffer, for to supply clean milk involves a considerable capital outlay, and can only be done with commercial success on a large scale. But by an extension of the principles of co-operation the small dairyman would gain in the long-run by securing a steady sale for his output.

What has been said about legislation applies also to commercial control; it is there, if we only take advantage of it. Provided that the public demand milk under such guarantees as to cleanliness and freedom from tubercle as the best dairy companies give, they will get an article the use of which will be attended by the minimum risk of infection by tubercle.

Domestic Control of Milk.

For practical purposes methods of procuring sterility by preservatives and otherwise may be discarded as altogether inferior to the simple process of heating. The principal question, then, is, *What temperature is needed to ensure the death of tubercle bacilli in milk?* Different replies have been given. Probably some of the discrepancies are due to the fact that if a pellicle forms on the surface of the milk, a higher temperature is required than would otherwise be the case. According to the careful experiments of Russell and Hastings,[2] exposure to 140° F. for twenty minutes in a closed pasteurizer (so that no pellicle forms) will certainly destroy the organism. Others have failed to get such good results, and have found that the organisms sometimes survived exposure to 158° F. for half an hour. All agree that the bacilli are killed by a temperature of 212° F.

We may take it, therefore, that pasteurizing usually, and boiling invariably, renders milk safe so far as tuberculosis is concerned. No one, I suppose, has any serious objection to the use of cooked milk as a component part of a mixed diet; but when, as in infancy, it is the sole food, certain disadvantages in comparison with fresh milk have been urged against it. Putting the question of taste aside, the principal

[1] See, for example, the Aylesbury Dairy Company's regulations in Appendices N, O, and P, Swithinbank and Newman: "Bacteriology of Milk." London, 1903.

[2] Russell and Hastings: "Seventeenth Annual Report of the Wisconsin Agricultural Experiment Station." 1900.

are—(1) that, by heating, part of the proteid is coagulated; (2) that scorbutus may be caused; (3) that children do not thrive well on it; (4) that its "vital properties" (enzymes, etc.) are destroyed. Now, every one of these objections is perfectly true, and it is equally true that none of them can be allowed to weigh against the great benefit of sterilization[1] or pasteurization. This is not the place to discuss the causes of scorbutus; but even admitting (which is far from proved) that sterilization *per se* can cause the disease, no one, I think, with any sense of proportion would balance the comparatively small risk of a curable affection like scurvy against the greater probability of disaster which attends the use of raw milk obtained under existing conditions. Every now and again, undoubtedly, a child will be found whose nutrition fails somewhat under sterilized milk, but it is unreasonable therefore to decry altogether sterilized milk as generally harmful. The thousands of perfectly healthy infants who are reared on nothing else furnish answer enough. Apart altogether from tubercle, the age of infancy is that which, above all others, demands sterilization or pasteurization to obviate the really serious risk of acute gastro-intestinal infection. For my own part, I do not think that pasteurization has any advantage over heating at 212°; but the method selected will depend on considerations which have reference to the mode of feeding adopted, not to the destruction of tubercle bacilli.

Naturally, the further precaution must be taken of storing the milk in closed vessels, and of debarring persons suffering from tuberculosis from handling it.

[1] To prevent misconception, may I say that by "sterilization" I mean heating to the boiling-point for any period not exceeding forty minutes? The preserved sterilized milk of commerce, prepared by heating at higher temperatures, must not be held to be included by the term as it is used in this paragraph.

V.

BOVINE TUBERCULOSIS IN CHILDREN.

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The problem indicated in the above title is one of extraordinary complication and difficulty. Physicians and surgeons of wide clinical experience and scientific acumen have been, up to the present time, unable to give an answer to the simple question, Does bovine tuberculosis cause tuberculosis in the human body? For many years it was the universal teaching of British physicians that tuberculosis in animals and man was precisely the same disease, and was caused by precisely the same bacillus. They believed that when the bacillus was introduced into the body of a child through the agency of infected milk an abdominal tuberculosis might be produced which was free to spread to the whole of the body; consequently, mothers were advised to boil or sterilize the milk before giving it to children. It was not until Koch pronounced his now famous dictum that "Tuberculosis of man and the cow were different, and that tuberculosis of the cow could not be conveyed to man, and that any regulations concerning milk, butter, and meat made against tuberculosis of animals and its transmission to mankind were not necessary,"[1] that extensive researches were commenced throughout the whole of the civilized world to prove or disprove this statement.

General Pathological Considerations.

It is a matter of the greatest difficulty to correctly assign the cause of an infection in a child suffering from tuberculosis, and it can only be by taking a general broad survey of tuberculosis in its clinical forms, together with a very extensive post-mortem research, that any general deductions of value can be made. The splendid experimental research

[1] Koch, R: Transactions of the International Congress on Tuberculosis. London, 1901.

work conducted by the English Royal Commission,[1] and also by the German Imperial Commission,[2] has now been published, and will, I think, settle for all time the one now undisputed fact that *human and bovine tuberculosis are different kinds of disease, and are caused by a different variety of bacillus*, and that, what we had long thought to be correct, the disease can be transmitted from the cow to the human. I need not here enter into the details of the complete experiments which have been made by these Commissions, or the method by which their results were obtained, excepting to say that, generally speaking, if a virus is virulent to bovines, it is classed as one of bovine origin. If, on the other hand, the virus is not virulent, or only slightly virulent, to bovines or rabbits, then it is classed as of human origin. When dealing with viruses of high virulence this method ought to be conclusive, but it is well known that various lesions of the human body, especially tuberculous glands, either in the mesentery or elsewhere, may be of particularly low virulence; in fact, the disease may be on the point of dying out completely, as it often does. When organisms from these cases are inoculated into bovines, the virulence will be extremely low; and hence they are liable to be classed as not of bovine origin when this really may have been the case.

The report of the Commission, however, is of sufficient importance to be reproduced here, and their conclusions are as follows: "There can be no doubt but that, in a certain number of cases, the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction into the human body of the bacillus of bovine tuberculosis; and there also can be no doubt that in the majority, at least, of these cases the bacillus is introduced through cow's milk. Cow's milk containing bovine tubercle bacilli is clearly a cause of tuberculosis, and of fatal tuberculosis, in man."

And again: "Of the sixty cases of human tuberculosis investigated by us, fourteen of the viruses belonged to Group I.—that is to say, contained the bovine bacillus. If, instead of taking all these sixty cases, we confine ourselves to cases of tuberculosis in which the bacilli were apparently introduced into the body by way of the alimentary canal, the proportion of Group I. becomes very much larger. Of the total sixty cases investigated by us, twenty-eight possessed clinical histories indicating that in them the bacillus was introduced through the alimentary canal. Of these, thirteen belonged to Group I. Of the nine cases in which cervical glands were studied by us, three, and of the nineteen cases in which the lesions of abdominal tuberculosis were studied by us, ten, belonged to Group I.

"These facts indicate that a very large proportion of tuberculosis contracted by ingestion is due to tubercle bacilli of bovine source.

[1] Second Report, 1907. [2] Report, 1905.

"A very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cow's milk containing tubercle bacilli. The presence of tubercle bacilli in cow's milk can be detected, though with some difficulty, if the proper means be adopted, and such milk ought never to be used as food. There is far less difficulty in recognizing clinically that a cow is distinctly suffering from tuberculosis, in which case she may be yielding tuberculous milk. The milk coming from such a cow ought not to form part of human food, and, indeed, ought not to be used as food at all.

"Our results point clearly to the necessity of measures more stringent than those at present enforced being taken to prevent the sale or the consumption of such milk."

The recent report embodying the results of the German Imperial Commission has just been issued by Dr. A. Weber. In it he expresses the opinion that the bacilli of tuberculosis must be divided into (1) *typus humanus* and (2) *typus bovinus*, both on the grounds of morphology, cultural characteristics, and virulence for rabbits and bovines. In eighty-four cases of tuberculosis in children which he exhaustively examined, he found that no less than twenty-one were infected with the bovine bacillus. Thirteen occurred in primary abdominal tuberculosis, six in cases of tuberculosis of neck glands, whilst of eighteen cases of lung tubercle all gave bacilli of the human type. These facts, which are now incontrovertible, demonstrate conclusively that bovine tuberculosis conveyed through milk is the cause of a large amount of tuberculosis in childhood. As I have before said, it is not yet possible to say definitely how much is thus caused, but my own opinion is that an even larger percentage than the figures above given can be traced to bovine infection.

Channels of Infection.

The next question of interest is, How is the bacillus introduced into the body? The recent work of Calmette[1] and others in experimenting on animals shows conclusively that the alimentary tract is a very common portal of entry for the bacillus. It has been conclusively shown that the infection may pass through the intestine without leaving any visible trace, may then enter the mesenteric glands, and so pass either into the lymph stream or the blood stream, and be conveyed to all parts of the body.

From my own observations and researches I am convinced that this is the most frequent method by which the human body is attacked —I am referring, of course, to tuberculosis in children—and that the bacillus is conveyed to the bronchial glands either by direct extension

[1] Calmette: Transactions of the Pasteur Institute, Lille.

from the abdomen through the lymphatics or through the blood stream, and thence directly to the lungs.

The conclusions of Calmette are of great importance:

1. That animals readily contract tuberculosis by way of the intestine, not only in youth, but also during adult life, without the passage of the bacilli through the walls of the digestive tube being marked by any visible lesions.

2. That in the case of young animals bacilli are ordinarily retained by the mesenteric glands. Sometimes the infection remains localized there for a longer or shorter period, and is in the end cured; sometimes it ends in the formation of caseous tubercles, and is then propagated by the efferent lymphatics to the major lymphatic circulation.

3. That in the case of adult animals whose defensive glandular reaction is much less active, the bacilli are more generally carried, with the leucocytes containing them, into the major lymphatic circulation, and by way of the pulmonary artery towards the lung.

4. That the so-called primary pulmonary tuberculosis is generally intestinal in origin.

5. Finally, that of all methods of infection, that by way of the digestive canal is at once the most efficacious, and that which best agrees with the normal conditions of natural infection.

Bovine Tuberculous Lesions in the Child.

The particular part of this problem which I have set myself to attempt to solve is, What are the particular lesions in the human body which are caused by the bovine bacillus? and I am grateful for the unique opportunity of having at my disposal an enormous amount of clinical and pathological material from the wards of a large hospital.

During the last fifteen years I have had under my care over 5,000 cases of tuberculosis in all its forms; of that number a fair proportion were cases of surgical tuberculosis occurring chiefly in children.

One or two facts have been particularly impressed on one's mind from a general survey of this large number of cases.

First: In pulmonary tuberculosis the tuberculous process is nearly always strictly confined to the lungs; in a fair percentage of cases the intestines show secondary tuberculous ulcers; but beyond this, by far the great majority of cases of phthisis show no other tuberculous lesion. It is essentially a disease of young adult life, the great majority of deaths taking place between the ages of thirty and forty.

Second: Strumous or tuberculous joints, enlarged glands, spinal disease, and abdominal tuberculosis with tabes mesenterica, are essentially diseases of infancy and childhood, and are only rarely seen in adult life.

I have given particular attention to the clinical manifestations of these various tuberculous affections, and it is rare to see a patient with enlarged glands, strumous joints, or spinal disease develop true phthisis pulmonalis; in fact, clinically they appear to be antagonistic to each other, attacking the body at quite different periods of life, and exhibiting generally opposite symptoms.

As a primary disease pulmonary tuberculosis seems to originate in the lungs as a result of inhalation of infecting tuberculous matter, and, secondarily, to cause tuberculous ulceration of the intestine by swallowing the sputum. Other forms of tuberculosis, such as enlarged lymphatic glands in the neck, tuberculous peritonitis, tuberculous joints, and probably tuberculous meningitis and lupus, are most likely caused by bovine bacilli being absorbed from the digestive tract in milk and other food, such as butter, butter-milk, cheese, sausage, etc.

Enlarged glands in the neck are, in my judgment, a great danger. In a great many instances the affection from the fauces and tonsils by infected milk is limited by the glands, which either suppurate or are removed by the surgeon. If the affection is allowed to spread downwards, the apex of the lung may be directly attacked, and an extensive bovine infection of the lungs may result. I have seen several instances where the glands in the neck have slowly been allowed to progress until the pleura was reached, the result being general bovine phthisis. For this reason it is of the highest importance that all tuberculous glands in children should be treated as quickly as they appear.

From my own observation, I would say that human tubercle bacilli do not attack the ordinary lymphatic glands of the body. I have just completed a series of over 200 carefully conducted autopsies on children dying of tuberculosis; many of these were ordinary phthisis, and several of them abdominal and meningeal tuberculosis. Of this number, fifty-eight showed tuberculous intestinal ulcers, with caseating mesenteric glands, and thirty-seven showed caseating mesenteric glands without intestinal ulcers. I am inclined to think that the tuberculous ulcers were caused by human bacilli, and that in those cases where the mesenteric glands were infected without ulceration of the intestine, the bacilli were of bovine origin. In short, human bacilli, whether primarily swallowed or as a secondary infection in phthisis, will cause intestinal ulceration, whilst bovine bacilli ingested with milk, etc., will readily pass through the intestine, leaving no trace behind, attack the mesenteric glands, and thence spread to the lungs and all over the body. It is possible that this may be a means in future of distinguishing the origin of an infection.

I have also been particularly impressed with the fact that children who suffer from the surgical forms of tuberculosis, such as tuberculous glands, joint disease, and lupus, very rarely indeed are attacked even

in the later stages of their malady by pulmonary tuberculosis. The lungs may be affected in the course of a general or miliary tuberculosis, but it is rare to see pulmonary tuberculosis associated with surgical tuberculosis. The cause of death in the great majority of these cases is exhaustion and waxy degeneration, so that I have come to the conclusion that these two varieties of tubercle are antagonistic to each other in the human body, and that children who have suffered from bovine tuberculosis in the form of strumous glands, spinal caries, strumous joints, and lupus, are immune against phthisis pulmonalis; very much the same result is produced by vaccination against small-pox. The work of von Behring and Römer corroborates this view. The only strain of tubercle bacilli which they found produce complete immunity in cattle was the human strain, and by using human bacilli they have been able to immunize thousands of cattle against bovine tuberculosis. If human bacilli will protect cattle, it is natural to suppose the converse—that bovine tubercle in children will protect them against human tubercle or phthisis.

To sum up my views on the distribution of tubercle in the human body, I would say, speaking provisionally and without final evidence of proof, that—

1. Tubercle bacilli of *typus humanus* produce pulmonary tuberculosis, tuberculous ulceration of the intestines, tuberculosis of the abdominal glands.

2. Tubercle bacilli of the *typus bovinus* produce mesenteric tuberculosis, tuberculous peritonitis, tuberculous glands, tuberculous affections of bones and joints, tuberculous meningitis, acute miliary tuberculosis, and probably lupus.

Therapeutic Considerations.

With regard to the present treatment of these various forms of tuberculosis in children, I am glad to report that since the routine treatment by tuberculin has been adopted we have observed most gratifying and beneficial results. Working on the hypothesis that the two forms of tubercle were different, and that one form conferred immunity against the other, I have lately been treating all cases of surgical tuberculosis in children with injections of tuberculin prepared from human sources, with the most excellent results; I refer, of course, to Koch's tuberculin (R). Conversely, suitable cases of phthisis pulmonalis have been treated with inoculations of tuberculin prepared from bovine sources, also with very excellent results. It would seem that bovine tuberculin has a special power of producing immunity in cases of infection by the human bacillus, whilst the tuberculin prepared from human sources rapidly confers immunity in affections of bovine

origin. The work is yet in its infancy, but, from a large experience of the treatment of such cases, I am convinced that this will be the treatment of the future, and I have never yet seen the slightest bad effect from its use.

Regarding what is perhaps the more important aspect of this problem—namely, the vaccination of children against tuberculosis—not much has at present been done. I have inoculated several children with small doses of bovine tuberculin, with the object of producing immunity against infection of human origin. All these cases were children of tuberculous parents, who had been exposed to infection at home. So far, none of them have developed tuberculosis; but, of course, it is too soon yet to draw any conclusions.

I have recently had under my care in hospital three children suffering from what appeared to be typical tuberculous meningitis. Although it was impossible to isolate the tubercle bacillus, yet there appeared to be no doubt as to their tuberculous nature. After several injections of Koch's tuberculin two of them completely recovered, whilst the third one died, evidently not influenced by the treatment. The improvement which follows tuberculin is most marked in tuberculous glands, which readily soften, and in many cases ultimately disappear. I have found, however, that it is not desirable to inject tuberculin where the glands are suppurating or inflamed. If this stage is reached the glands should be removed by the surgeon. In cases of extensive tuberculosis of the peritoneum with ascites, tuberculin has a magical effect; whilst in tuberculous sinuses, tuberculosis of the bladder, genital organs, and lupus, the effect is even still more marked. In my judgment, when the time comes for the extermination of tuberculous dairy cows, the so-called surgical forms of tuberculosis in children will entirely disappear. At the present time I notice a remarkable diminution of the amount of surgical tuberculosis in children in the City of Liverpool, which I attribute entirely to the energetic measures which have been adopted by the health authority towards safeguarding the milk-supply of the city. Even yet from 10 to 15 per cent. of all milk delivered into large cities is tuberculous, so that we cannot be surprised at the amount of tuberculosis which is conveyed from the alimentary tract.

General Conclusions.

I venture to think we may summarize our present position thus:

1. Human and bovine tuberculosis are different varieties of a common species.

2. The human body is susceptible to both forms.

3. Bovine tuberculosis is frequently conveyed to humans, both by means of infected food and by contagion.

4. These two forms of tubercle are antagonistic to each other.

5. A mild attack of bovine tuberculosis protects against phthisis pulmonalis.

6. Tuberculin from human sources has a marked curative effect on bovine lesions.

7. Tuberculin from bovine sources has a curative effect on pulmonary tuberculosis.

VI.

TUBERCULOUS AFFECTIONS OF THE NERVOUS SYSTEM IN INFANCY AND CHILDHOOD.

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It would be impossible in the space allotted to this article to describe in detail all the many and varied forms and manifestations of tuberculous involvement of the nervous system in infancy and childhood. I shall therefore only consider those lesions which are of most frequent occurrence and are of the greatest clinical importance.

Ætiological Factors.

Predisposing Causes. — These do not differ essentially from those leading to tuberculous involvement of the other organs of the body. Inasmuch as the affection of the nervous system is in the vast majority of cases secondary to a local tuberculous focus elsewhere in the body, the important factors of contagion, food and air infection, are matters for important consideration.

Leaving this matter, however, to be dealt with by those who have the subject of visceral tuberculosis for their province, a consideration of the ætiological factors in the development of tuberculosis of the nervous system divides itself naturally into (1) the determining factors, (2) the predisposing conditions, and (3) the methods of transmission.

Taking the most common forms of tuberculosis of the nervous system, tuberculous meningitis and tuberculous "tumours," as they are often called, we find that while these may occur at any time of life, they occur with much greater frequency in infancy and childhood.

While tuberculous meningitis is rare during the first and second years of life, the majority of cases are met with before the fifteenth year. While poor nutrition is an important factor, it is not uncommon

to see an inflammatory condition of the meninges develop in full-blooded and well-nourished children. Operative procedures on the lymph glands, adenoid growths, and especially tuberculous bones and joints, may be the determining factor of a blood infection which has its most intense clinical manifestation referred to the cerebro-spinal axis.

While we may safely assume that tubercle bacilli are circulating in the blood in terminal cases of pulmonary tuberculosis, the tissue resistance of the nervous system, and what might be termed a visceral or cellular immunity, prevents a lodgment of the bacilli and the formation of inflammatory lesions.

In early cases where no such immunity is developed, and where the quantity or virulence of the invading organism is in excess of the resistance, we may expect a development of meningeal trouble. Acquired immunity from the mother may to a certain extent explain the frequency of chronic forms of tuberculosis in the brains of new-born children. The resistance to the invasion of tubercle bacilli is well exemplified in cases of unilateral meningitis localized to the distribution of one or more bloodvessels.

An important matter for consideration is the influence of mixed types of infection in the determination of meningitis. I have seen, both in the human being and in the lower animals, a tuberculous type of meningitis, presenting both tubercle bacilli and pyogenic organisms in the exudate, develop after a sudden mixed infection. This may be due either to the lowered tissue resistance caused by the mixed infection, or to the combined actions of the mixed organisms upon the meninges.

Besides those cases due to a direct blood infection, there is a group of cases in which the meningeal process is secondary to a tuberculous focus in the bones of the skull or of the spine, the mastoid cells, or the osseous structures of the orbit and nasal fossa, etc. From these areas the tuberculous infection may be by local extension, but it is more frequently by lymphatic transmission.

In tuberculous "tumours" of the brain, placental transmission from the parent must be considered an important factor, otherwise it is impossible to explain the case of Demme,[1] who found in a child twenty-three days old, from a tuberculous mother, a tuberculous tumour of the cerebellum the size of a hazel-nut. Henoch[2] also reports tubercles in the brains of children from nine months to two years of age as not an infrequent occurrence.

Tyromata constitutes the most frequent form of cerebral tumours met with in infancy and childhood. Starr found in 300 brain tumours in childhood tubercles in 152. Of 100 cases reported by Hale White, 45 were tuberculous.

[1] Demme: "Jahresbericht des Berner Kinderhospitals," xvii. Berlin.
[2] Henoch: "Lehrbuch der Kinderkrankheiten," vii. Auflage. Berlin, 1893.

Traumatism cannot be considered an important direct factor in the production of tuberculosis of the nervous system. Its influence in the production of tuberculous lesions of the spinal meninges is secondary to its production of bone disease.

Pathological Considerations.

The pathological processes in the nervous system due to tuberculosis are essentially the same, with a few minor exceptions, to those seen in tuberculous involvement of other organs. It is not uncommon, however, to find profuse proliferative inflammatory processes of the meninges without the presence of tubercles. A cellular proliferative process met with in the lower animals, but of rare occurrence in the human being, offers this same type, spreading along the bloodvessels into the brain substance, and giving an appearance not unlike that seen in endotheliomata.

Formation of massive tubercles in the brain gives a macroscopic appearance so similar to gummata that the presence of the specific organism is necessary to make a diagnosis. Giant cells are of rare occurrence in the cerebral tissues.

Tuberculous tumours differ from other types of cerebral tumours in being of an infiltrating rather than of a destructive nature. As a result of this, the conducting axis cylinders may not be destroyed, but persist in the substance of the tumour.

Tuberculous tumours of the brain are usually multiple. Gowers found a single tuberculous tumour in 83 out of 183 cases. In the others as many as twenty tumours were found in a single specimen. They vary in size from a split-pea to a goose-egg. They are most frequently found in the cerebellum and the pons. An entire hemisphere of the cerebellum may be transformed into a tuberculous mass. The smaller tumours may undergo organization and in some cases calcification. The larger tumours may caseate, form abscesses, or produce meningitis by extension.

The most common form of tuberculous meningitis in childhood is an eruption of miliary tubercles along the course of the bloodvessels. This is associated with an intense inflammation of the pia-arachnoid. In practically all cases there is an associated hydrocephalus. In some cases this is due to an inflammatory condition of the ependyma of the choroid plexus, in others to a blocking-up of the lymph channels at the base of the brain. It is not uncommon to find a fibro-plastic exudate more marked over the base of the brain in the intra-crural spaces. In the subacute forms this exudate shows a tendency to organization, and what may be termed a "proliferating" type of meningitis results. When there is a mixed pyogenic infection, a semi-purulent type of exudate is found over the base of the brain. In rare mild forms of

tuberculosis of the meninges small organized tubercles are sometimes seen scattered over the convexity and mesial surface of the brain, without evidence of other inflammation of the pia-arachnoid.

A chronic proliferating form of tuberculosis of the meninges, more or less localized (tuberculosis en plaque), may be associated with tumour of the brain substance, or occur as an independent affection.

Tuberculous pachymeningitis is usually the result of extension of tuberculosis of the bones to the dura. That is practically the same condition which is seen in Pott's disease. In the milder cases an irritative lesion of the dura is produced, with proliferation of the connective tissues and marked thickening. This condition may, however, be complicated by transformation into an active chronic tuberculosis of the dura, with caseation, softening, and a further extension of the process, to the pia-arachnoid and cerebral or spinal tissues. In the brain this leads at first to pressure and later to infection; in the spine to pressure on the cord, and at times infiltration and destruction of the cord tissue.

It is not infrequent to find multiple types of lesions in the same case. A tumour of the brain may be associated with a tumour of the spinal cord, and chronic or acute meningeal changes either of the brain or of the cord. In this respect the lesions in their multiplicity and irregularity of distribution resemble cerebro-spinal syphilis and multiple sclerosis.

Tuberculous myelitis is either an extension of a meningitis to the substance of the cord, or is the result of pressure of a tuberculous exudate around the cord. Varying types of exudates associated with subacute or chronic tuberculous processes of the spinal meninges are seen. A fibrinous exudate, with a proliferation of the endothelial or fixed connective-tissue cells, localized to the inner surface of the cervical dura, is not an uncommon occurrence in a patient dying from an advanced pulmonary tuberculosis. A gelatinous exudate is sometimes seen within the pia-arachnoid. In two cases I have seen a peculiar fungiform mass scattered here and there over the spinal meninges, several millimetres in thickness, very friable, and showing under the microscope a loose connective-tissue reticular infiltration with small round cells.

Tuberculous encephalitis may be found in an otherwise healthy brain, and may form the nidus for a tuberculous tumour, or may undergo a retrograde process with abscess formation. Secondary areas of encephalitis may be associated with intense forms of tuberculous meningitis.

Tuberculous neuritis is the result of tuberculous or mixed toxins upon the peripheral nerves.

The Signs and Symptoms of Tuberculous Meningitis.

The manifestations of tuberculous disease of the nervous system must necessarily depend upon the nature and multiplicity of the lesions and the portions of the nervous system affected. It would be impossible in a limited paper to outline the full symptomatology of all the affections above described.

In tuberculous meningitis there is a wide variation in the symptoms prescribed, depending on the type of meningitis and the portion of the brain affected. In a virulent affection with low resistance, the disease may terminate in seventy-two hours. In other cases the disease may be prolonged over several weeks. The evidence of disturbance of cerebral function is usually very marked in childhood, but as adult life is approached, and more particularly in cases where there is advanced pulmonary tuberculosis, the cerebral symptoms may be relatively minor. I have seen cases of this latter group which only merely presented moderate headache, Kernig's symptom, and the Gordon paradoxic reflex with mild delirium, for a day or two preceding death. The condition, as it occurs in infancy and childhood, presents a clinical picture varying with the intensity of the inflammatory process, the presence or absence of exudate, the degree of internal hydrocephalus, and of complicating cerebral intoxication.

The clinical picture may conveniently be divided into three stages:

1. *Stage of Invasion.*—For a varying period of time (a few days to several weeks) the child may lose weight, be peevish, irritable, restless, and have a slight temperature, usually rising to about 100° at night. Headaches and constipation are the rule during this period, but both may be absent. This stage may gradually or suddenly pass into the next.

2. *The Stage of Inflammatory Irritation.*—The fever increases somewhat, the headache is more marked, and photophobia and hyperacousis become prominent symptoms. The irritability is increased, the child lying in a semi-somnolent condition, answering, when spoken to, in a peevish manner. The pulse is slow and irritable, and markedly quickened by exertion or irritation. Vaso-motor phenomena, such as alternate flushing and paling of various parts of the body, followed by marbling of the skin in the later stages of the disease, are prominent symptoms. Motor phenomena are usually very marked. Rigidity of the muscles of the neck and of the back, retraction of the head, grinding of the teeth and jaws, pulling up of the corners of the mouth, and various types of strabismus, are present. Rigidity and contraction of the limbs may be noted with increase of the reflexes. Partial or general convulsions may occur or may be absent throughout the entire course of the disease. Even when convulsions are absent,

twitching and jerking of the extremities are observed. Variations of the respiratory rhythm present an important clinical symptom. The pupils early in this stage are contracted, but later become dilated, and at times may be unequal. Kernig's symptom, Babinski's reflex, and the Gordon phenomenon, are all present during this stage of the disease. The ophthalmoscope reveals, in the majority of cases, a moderate choking of the disc, and, in a relatively small number of cases, miliary tubercles of the choroid. The child, after several days, becomes stuporous, and finally passes into the last stage.

3. *The Stage of Coma and Paralysis.*—The child is now unconscious; the spasm of the neck, back, and of the extremities relaxes; the pupils are markedly dilated, the eyeballs turned outward and upward, the lids are half closed, and complete blindness is present. The pulse is very rapid, the respiratory rhythm is irregular, the superficial temperature is subnormal, the rectal temperature usually high, although it may be subnormal. Convulsions may occur, but are, as a rule, very light and limited as to time and distribution. They may, however, be as intense at the end as at the beginning of the second stage, and may be followed by a temporary paralysis. The paralysis of this stage is, however, usually permanent, due to destruction of the nerve tissues. The extremities are flaccid and relaxed, there is complete paralysis of the eye muscles, a dropping of the angles of the mouth with loss of expression, and a paralytic condition of the jaw. Sometimes retention of urine occurs toward the end of this stage. As the end approaches, cyanosis and lividity of the skin and mucous membranes appear, the extremities and trunk become cold, and death slowly takes place. Death sometimes follows a general convulsion.

Diagnosis.—The diagnosis of tuberculous meningitis from other forms of meningitis depends on the discovery of some active or latent focus of tuberculosis elsewhere in the body, and the presence of tubercle bacilli in the cerebro-spinal fluid. While the clinical picture in some cases is typical, it often does not differ essentially from that presented by other forms of meningitis. A prolonged prodromal period with constipation, bradycardia, slight elevation of temperature, with the pulmonary and ocular symptoms above described, will differentiate the tuberculous from other forms of meningitis. The non-tuberculous forms of meningitis may be distinguished by the suddenness of the onset, the absence of prodromes, the initial fever, and the rapidity of the course. When the meningeal infection is a part of a general miliary tuberculosis affecting other organs a typhoid state may be present, leading to a diagnosis of typhoid fever with symptoms of meningeal irritation. The absence of leucocytes and the presence of the Widal reaction in the blood, and the absence of tubercle bacilli in the cerebro-spinal fluid, should easily differentiate the two conditions.

From brain tumour in children the diagnosis is made from the slow onset of the symptoms in tumours with the absence of fever, the greater intensity of the optic neuritis, and the presence of localizing symptoms.

Treatment.—The treatment is entirely symptomatic. A purgative in the early stage is indicated; ice-bags to the head or along the spine to control the pain, a proper nourishing diet, and a quiet, darkened room will add to the comfort of the patient. The surgical treatment (opening the skull by trephining, and, more recently, by a large osteo-plastic flap), practised by Agnew in 1891, and by Ord and Waterhouse, Jaboulay and others, has been successful only in one case; but in view of the hopeless nature of the affection, it is deserving of more extended practice. The theory upon which this treatment is based is, that the exposure of the meninges to the air should have the same beneficial effect as in tuberculous peritonitis, and should also relieve the increased intra-cranial pressure. The use of lumbar puncture in cases where the cerebro-spinal communication is open produces an amelioration of the symptoms without, however, any permanent results. The injection of antiseptic solution into the cerebro-spinal canal has not proved of any value.

A tuberculous meningitis, circumscribed and confined to some one portion of the meninges, is not of such frequent occurrence as the condition above described. Fraentzel[1] records a case where the tuberculous process was confined to the vessels of the choroid plexus. Repeated spells of unconsciousness with contractions of the face muscles and death in thirty hours were the only symptoms.

I have elsewhere[2] described in detail a striking case of the mixed purulent form which presented the lesions of a typical tuberculous meningitis confined to one cerebral hemisphere, and more particularly to the distribution of the Sylvian artery. The case is of considerable interest, both from a clinical and pathological standpoint. It represents, from a pathological standpoint, a method of infection of the cerebral meninges from a pulmonary lesion. The localization of the inflammation to the distribution of one cerebral artery is, I take it, clear evidence of the transmission of the infection through the arterial circulation.

Local areas of tuberculous meningitis are often found in tuberculous tumours of the cortex or areas of encephalitis. Circumscribed tuberculous meningitis of the spinal membranes is more frequent. The symptoms, due to the irritation of the anterior and posterior roots, will depend on the location of the inflammation. In the cervical region violent contractions in the arm, forearm, shoulders, and breast, with or without sensory disturbance and pain, may occur. There is usually

[1] Fraentzel: "Eichhorst, Spec. Pathologie u. Therap." Vte. Auft., B. iv., S. 629, 1897.

[2] McCarthy, D. J.: "Second Annual Report of the Henry Phipps Institute." Philadelphia, 1906.

diminution in power and increase of the reflexes. Wasting may be present. In the lumbar region of the cord there may be various paræsthesiæ, numbness, tingling, etc., of the lower extremities, followed by pain, and after several months paralysis more or less complete, with bladder and rectal involvement. In a case of this kind which came under my observation a few years ago there developed in a patient suffering from pulmonary tuberculosis and tuberculosis of the genito-urinary tract vague pains in the extremities, followed by weakness of the legs, spasticity, and loss of bladder control. The symptoms progressed for several weeks, and the patient died from an intercurrent affection, but autopsy was refused. These cases usually last several months, and at times present the symptoms of a chronic myelitis.

Tuberculous Tumours of the Brain in Children.

The symptoms presented by tuberculous tumours of the brain do not differ materially from those presented by other forms of brain tumour. It should, however, be remembered that on account of its very slow growth and the infiltrating type of tumour symptoms may be entirely wanting. This is particularly true when the tumour occurs in the so-called silent areas of the brain. Headaches, optic neuritis, vomiting, are fairly constant where symptoms are produced. If the cortex is involved there may be convulsions, or this may be due to secondary changes in the meninges. Focal symptoms may be present, and depend upon the particular portion of the brain involved. In the large majority of the cases the involvement of the cerebellum causes a very high grade of optic neuritis with a distension of the retinal veins and hæmorrhages, a staggering, drunken type of gait, forced movements to one side or the other, a forced position, and a certain clumsiness of movement of the affected side. Cranial nerve symptoms, especially paralysis of the face and deafness, may result from pressure or involvement of the pons. Involvement of the superior peduncle of the cerebellum is associated with nystagmus and paralysis of the ocular muscles. Not infrequently, on account of the presence of multiple tuberculosis, a strict localization of the process becomes impossible. The diagnosis of a tuberculous tumour of the brain must depend upon the presence of tuberculosis elsewhere in the body, on the history of exposure to tuberculosis, or the presence of tuberculosis in the family. I was led astray in diagnosing a tubercle in the cerebellum in a boy twelve years of age (which upon operation proved to be a glioma) by the presence of an associated tuberculosis of the lungs. The diagnosis of this type of tumour must necessarily be tentative.

Treatment.—When the evidence points to the presence of a single localized tumour mass an operation for its removal is advisable. Even in cases of multiple and infiltrating types of tuberculous tumours an

operation is advisable to relieve the pressure and control the headaches, to save the eyesight, and to make the patient comfortable. In cases where the evidence points to the same lesion, and where the symptoms are not progressive, an open-air treatment with careful attention to the general nutrition, overfeeding, etc., is advisable. Headaches may be relieved by the use of phenacetin, acetanilid, etc., the use of ice-bags, and free purgation. Epileptiform convulsions may be kept in check by the use of bromides.

Solitary tubercles of the cord occur most frequently in the lumbar swelling. They may reach the size of a hazel-nut and produce no symptoms at all, or the symptoms of a spinal tumour. A progressive spastic paraplegia, going on to complete paralysis of function below a definite spinal segment; tenderness to percussion over a localized area of the spine, and often setting up a clonus of the lower extremities when the lesion corresponds to the lumbar enlargement; lancinating pains, and pain localized to the area involved, with sensory disturbances, unilateral or bilateral below the point of lesion—symptoms of a slowly progressive destruction of one or more segments of spinal marrow in a tuberculous patient—should suggest the presence of a solitary tubercle of the cord.

Multiple tumours of the cord sometimes occur, and I have at present two spinal cords exhibiting multiple tuberculous lesions. In one of these, the cord of a child dying of spinal caries and general tuberculosis, there were two tumours of the cauda equina—one the size of a large pea, the other the size of a hazel-nut. The spinal cord was pressed markedly to the right, and in an otherwise healthy cord anæsthesia of the perineum and buttocks should have been present. In the other cord there was an infiltrating tumour the size of a large hazel-nut, involving the entire cauda, and higher up a marked pachymeningitis and myelitis without disease of the vertebræ.

Secondary Involvement in Tuberculous Disease of the Spine.

Several interesting conditions of the cord and its membranes occur in connection with tuberculous caries of the spine (Pott's disease) with or without deformity. Simple deformity of the spine rarely causes symptoms referable to the cord. It is only when the outer covering of the cord undergoes low-grade inflammatory changes with the deposit of a thick exudate on its outer surface, and an infiltration and thickening of the normal fibrous tissue of the dura, that symptoms are produced. In the early stage this pressure leads to a certain amount of flattening of the cord, œdema, and lymph stasis; the complete recovery from the paraplegia and the other symptoms under rest and extension indicates that no serious destruction of the cord tissue has taken place. When, however, there is an extension of the inflam-

matory process to the cord substance, with segmental softening and destruction of nerve cells and fibres, the lesions are permanent and the symptoms persist. The exudate of the outer surface of the dura may reach half an inch in thickness, and the cord itself be reduced to a mere thread. The symptoms of Pott's disease, apart from the symptoms produced from the diseased bone, will depend on the location of the diseased process. In cases of the dorsal spine, the region most frequently affected, the following symptoms are usually present: Paralysis of the legs, progressive and spastic in type, with increased skin and tendon reflexes and ankle clonus; anæsthesia reaching as high as the root, destruction of the area involved, and often bladder and rectal disturbances. Trophic bed-sores on the back and hips occur, although the normal electrical reactions may be present. If the lumbar spine is involved, a flaccid, instead of a spastic, paralysis with lost reflexes may be expected. High cervical caries may give paralysis of the tongue and other bulbar symptoms, nystagmus, cervical neuralgia, etc. Low cervical caries may produce atrophic paralysis of the upper extremities, while caries above the cervical swelling may give a spastic paralysis of all four extremities. The diagnosis of pressure paralysis from Pott's disease is easily made, in the great majority of cases, by the deformity and other evidence of tuberculous bone trouble. Serious symptoms may be produced by an epidural tuberculosis independent of any carious process in the spine (Schlesinger), and an abscess circumscribed to one or more vertebræ may rupture into the spine without evidence of bone disease or appreciable deformity. An old man, seventy years of age, a ward assistant in the service of Dr. Charles W. Burr at the Philadelphia Hospital, who never presented any other symptoms than the stiff carriage common in old men, suddenly fell to the floor one day with a paralysis of both lower extremities; the reflexes were retained; there was incontinence of urine and fæces, and anæsthesia of both extremities. There was no deformity, no pain, no tenderness to deep percussion over the spine, and yet at autopsy, a few weeks later, there was found an abscess, originating in the body of the third dorsal vertebra, and rupturing into the spinal canal, with destruction of the cord at that point. The symptoms from their sudden onset, without unconsciousness and without root symptoms, suggested intraspinal hæmorrhage. In carious processes beginning in adult or in late life, when the spine is fixed in its growth, deformity is not so likely to be produced, or to be so extensive as in early life.

Tuberculous Affection of the Peripheral Nerves.

Tuberculous mono- or poly-neuritis is the only tuberculous process occurring in the peripheral nerves. It occurs during the course of pul-

monary tuberculosis, and is often seen in the lower animals injected with tuberculous material. In a patient suffering with advanced pulmonary phthisis there developed, rather suddenly, a flaccid paralysis of both legs. The reflexes were lost and there was tenderness, not only along the course of the nerves, but also over the muscles themselves. There was a partial return of power, but the patient died at the end of two months. When the nerves are examined microscopically in such cases, no tubercle bacilli are found, and the nerves present the same changes as are seen in other toxic degenerations.

An interstitial inflammation of one or more of the nerves formed from the brachial plexus is sometimes seen in advanced cases of pulmonary tuberculosis with cavity formation. There is usually marked pain and tenderness, a loss of power, a disturbance of sensation, and atrophy and wasting. Tenderness of the extremities is most often due to a neuritis or to a marked sensitiveness of the periosteum of the long bones. In the neuritic condition the reflexes are lost. In the periosteal tenderness the reflexes are increased.

Mental Derangement in Tuberculous Disease.

Two forms of tuberculous insanity have been described, one by Clouston, where the element of suspicion is dominant, and the pseudo-paretic form, described by myself. Both of these, as a rule, occur in adult life. There is, however, a very distinct relation between the adolescent forms of insanity—dementia præcox—and tuberculosis. Exactly as to what this relationship is has not been definitely worked out. An investigation of a tuberculosis pavilion of one of our large insane asylums revealed the fact that practically all of the patients isolated in this pavilion were cases of dementia præcox. Whether a lowering of nutrition, due to a latent tuberculosis, is a determining factor, or whether, on the other hand, the stimulation of the higher nerve centres, that often comes with early tuberculosis, induces those of a sensitive cerebral mechanism to overwork and overstrain, which leads to the mental disturbance, is a matter for consideration. From my own investigations, I am rather inclined to the view that a very marked deficiency of the respiratory excursion in this group of cases, associated with disturbed function of the thyroid gland (with its influence upon oxygenation of the blood), predisposes the individual to the tuberculous infection after the development of the mental condition.

Neurotic asthenoid states, such as hysteria, neuritis, psychasthenia, etc., might be expected to occur in patients suffering from tuberculosis. Whether there is any causative relation between the two conditions other than the low vitality of the organism which predispose to such nervous states is a question. In early life attacks of hysteria have at times marked the onset of a pulmonary tuberculosis long before the

lung condition is suspected. Neurasthenia is so often a manifestation of a latent tuberculosis of the lungs in late childhood and early adult life that we cannot be too careful in excluding not only these, but other visceral pathological states, before diagnosing simple neurasthenia.

Tetany and Convulsive States in Tuberculous Children.

Tetany is sometimes met with in childhood, complicating tuberculosis of the lungs or of the lymphatic glands. Recent investigations of the para-thyroids as a cause of tetany would lead us to consider carefully in this case as to the possibility of a tuberculosis of this structure. I have had for the past two years a case of tetany in a boy suffering with glandular tuberculosis, but who does not present any evidence of tuberculosis either of the thyroid or of the para-thyroids. It is interesting in this connection to notice that Stumme[1] has reported a case of tuberculosis of the para-thyroids with Basedow's disease.

Epileptic and hysterical convulsions are not infrequent in tuberculosis in childhood. A careful study of the clinical manifestations will easily differentiate the hysterical convulsion from the true epileptic convulsion, and the essential epilepsy from that due to organic tuberculosis of the brain.

Functional Nervous Derangements in Tuberculous Children.

While persistent headaches during the course of tuberculosis should always suggest the possibility of meningeal involvement, it should be remembered that it is most often due to other conditions—anæmia, fever, eye-strain, etc. This latter cause cannot be too strongly insisted upon. The eye muscles share in the wasting and weakness of the general muscular system. Loss of muscular balance, and more particularly of convergence, results. The eye movements are very likely to be jerky, and not infrequently approach the condition known as nystagmus. Using the eyes for fine work, such as reading, sewing, etc., in this condition is very likely to cause headache. Reading while in a recumbent position is a very common practice among tuberculous patients, and causes an additional strain upon the already overworked muscles.

The treatment of functional disturbances of the nervous system complicating tuberculosis does not differ essentially from the treatment of the same conditions when not so associated.

[1] Stumme, E.: *Deutsche Zeitschrift f. Chirurgie*, xc., S. 265, 1907.

VII

TUBERCULOUS AFFECTIONS OF THE NOSE AND THROAT IN CHILDHOOD.

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ALTHOUGH tuberculous disease of the naso-pharynx is uncommon in early life, developmental defects, inflammatory conditions, and other lesions, are frequently met with, and undoubtedly exercise an influence in predisposing to tuberculous involvement in later life. It will thus be seen that it is almost impossible to avoid dealing with disease processes of the nose and throat as seen in adult life, if we would obtain directing light as to the best means for securing an adequate hygienic management of these regions in infancy and childhood.

Incidence of Tuberculosis in the Naso-pharynx.

Though the nose and throat provide a portal for the entrance of tubercle bacilli, the actual incidence of tuberculosis in this region is by no means common, if we except lupus. Lupus, generally speaking, is a disease of the poor, and is associated with defective hygiene. In three-quarters of Christiansen's[1] cases at Copenhagen the nose was affected. The septum is usually first attacked; the disease may then extend to the floor of the nose, and invade the mucous membrane and the inferior turbinal. Escat[2] believes that infection starts in the nose, and extends from thence to the skin and mucous membrane of the tongue, larynx, and pharynx. Steward[3] has collected a hundred cases of other forms of tuberculosis of the nose—*e.g.*, tuberculoma and ulcer—from a great many sources. Only nine of these were children, completion of the fifteenth year being taken to mark the limits of childhood. Six of these cases were "tuberculomatous" in character.

[1] Christiansen: *Journal of Laryngology*, xviii., p. 50, 1903.
[2] Escat: *Annales de Maladies de l'Oreille*, October, 1905.
[3] Steward, F. J.: Guy's Hospital Reports, vol. liv., p. 249. 1897.

In two there were single ulcers with nodules; one had acute tuberculosis, and the other pulmonary trouble. The ninth case presented a single ulcer with lung involvement.

In the naso-pharynx lupus is infrequent, and tuberculous ulceration is still rarer. Though pulmonary tuberculosis is considered to be by no means common in childhood, in whom tubercle more usually affects the glands, we may assume from Walsham's[1] work on consumptive adults that tonsils, adenoids, lingual tonsil, and pharyngeal nodules in such cases are all affected with tubercle. Sokolowski[2] excised nodules of lymphoid tissue from living consumptives, and found them microscopically tuberculous.

Miliary tubercles are rarely seen in the pharynx, and occur as infrequently as ulceration of the posterior wall of the pharynx. The latter is probably an extension of the condition described by Sokolowski. The presence of tubercles in adenoids removed from ordinary cases has offered a field for much research. Lewin[3] found 45 positive results in 905 cases published by various authors. Lartigan and Nicoll's[4] results gave 10 per cent. with tuberculous lesions, and another 6 per cent. with tubercle bacilli, On the other hand, the inoculation experiments of MacFadyen and MacConkey[5] gave negative results in forty-four cases. In reconciling these apparently opposite results, it may be noted that the latter experiments were not controlled by microscopic investigation, and that the distribution of tubercle bacilli is extremely variable, to say nothing of possible variation in the virulence of the bacilli, and the resisting power of their host.

It would seem that the lymphoid tissue of the pharynx is particularly prone to favour the entry and development of the tubercle bacillus. The tuberculous process, however, only occasionally ends in ulceration. In the case of the nose, with the exception of lupus, which is probably inoculated by means of the finger-nail at the junction of skin and mucous membrane, direct infection is mostly successfully warded off, and secondary infection is rare.

Sources of Tuberculous Infection.

In dealing with tuberculous affection of the naso-pharynx in children, it is unnecessary to enter into the more general discussion of hereditary predisposition and direct infection, except to call attention to the probability that both usually go together. Nebelthau and others[6] were

[1] Walsham: "The Channels of Infection in Tuberculosis." London, 1904.
[2] Sokolowski: *Frænkel's Archiv f. Laryngologie*, Bd. xiv., Heft iii. 1903.
[3] Lewin: *Archiv f. Laryngologie*, Bd. ix., S. 377. 1899.
[4] Lartigan and Nicoll: *American Journal of Med. Science*, C. xiii., p. 1031. 1902.
[5] MacFadyen and MacConkey: *British Medical Journal*, ii., p. 129. 1903.
[6] Nebelthau, Schwede, and Blumenfeld: "Therapie der Chronischen Lungenschwindsucht." 1904.

able to find some continuous source of adult infection in nearly all carefully investigated cases of tuberculous children. While active pulmonary tuberculosis is unusual among school children, still, infection may take place at school from such cases. It is well to remember, also, that adults with tuberculous discharges often have access to village and other schools, and here, where there is usually deficient ventilation, the dust may harbour infection. Towels are also a ready source of the infection. In the home of a tuberculous adult the dangers run by the child are relatively greater. The dust from a room inhabited by a phthisical patient has been found virulent after six weeks. The cough-spray from a tuberculous patient will infect gelatine plates at a distance of 1 metre. In the Charité experiments twenty-nine attendants in consumptive wards carried plugs of cotton-wool in the nose for a day, with the result that nine of the plugs were found to contain tubercle bacilli.

Children are frequently associated with chronic consumptives. Infants, on account of their stature and habit of crawling on the floor, and tentatively sucking dropped comforters or soiled thumbs, are particularly exposed to infection by dust bacilli.

It is probable that the continuous exposure of the naso-pharynx in the children of tuberculous parents to large numbers of bacilli, aided by certain predisposing conditions, determines infection. When the mortality from tubercle after tracheotomy for diphtheria is recalled, the importance of such predisposing causes, besides that of heredity, is obvious; while the presence of healed or quiescent tubercle in 60 to 70 per cent. of bodies dead from all causes is proof of the prevalence of infection and the variable resistance of individuals.

Channels of Infection in Early Life.

Evidence is accumulating to prove that tuberculous infection usually takes place in early life. Von Behring's views are certainly gaining ground; he considers that there is experimental and clinical evidence to show that febrile attacks represent a phase of tuberculous infection with reaction of lymphatic and vascular tissues. Nägeli[1] affirms that 33 per cent. of children under five show some tuberculous lesion. In spite of Nägeli tracing infection from mediastinal glands to cervical, this route must be regarded as only exceptional. Many consider that cases of tuberculosis of the lungs in children are due to infection consequent on tuberculosis of the bronchial glands. Sclenker[2] described an ascending route of infection from the mesenteric

[1] Nägeli: "Uber Haufigkeit Localisation und Ausheilung der Tuberculose," *Archiv. f. path. Anat.*, Bd. clx. 1900.

[2] Sclenker: "Beiträge zur Lehre von der menslichen Tuberculose," *Virchow's Archiv.*, Bd. cxxxiv., S. 145. 1893.

glands (which Harbitz[1] estimates to occur in 25 per cent. of cases), and a descending one from the upper respiratory tract. The facilities for entry of bacilli into the lymphoid tissue of tonsils, adenoids, and other lymphoid tissue of the upper respiratory tract are numerous. Walsham has adduced evidence to show that tuberculous invasion through the walls of the bronchi and œsophagus is possible. From the lymphoid tissue of these regions the bacteria are transported to the bronchial and cervical glands. Harbitz made 275 post-mortems on children dying in hospital, and found 117 tuberculous. Of these 117, 61 died of tubercle; 27 were the subjects of tuberculosis of glands; in 18 tubercle bacilli were discovered latent in the glands. In two only of this last class were the cervical glands free, while the mesenteric were involved in only three. The affected glands were usually slightly enlarged, and occurred in infants. MacFadyen and MacConkey tested glands in twenty-eight cases by inoculation. Of eight glands from indubitable tuberculous cases, only five gave a positive result; on the other hand, eight out of the twenty non-tuberculous cases showed the presence of tubercle bacilli. Oehlecher[2] has observed that four out of twelve cases of tuberculosis of the glands of the neck were due to bovine tubercle.

There are three types of glands which commonly contain tubercle bacilli: (1) The large gland, soft to the finger, exhibiting either pearly tubercles or caseous degeneration; such contain tubercle bacilli in large numbers. (2) The large, hard homogeneous gland, which reveals giant cells and relatively few bacilli. (3) Slightly enlarged nodes. These last may contain bacilli, but no tuberculous structure. The first two classes may be said to constitute scrofulous deposits. Various degenerations may coexist. The clinical types characterized by (*a*) peri-adenitis, (*b*) general lymphatic involvement, are comparatively rare. Class 3 occurring as the enlarged glands associated with adenoids and tonsils are the result of septic absorption, and frequently, according to the locale, contain tubercle bacilli. Laser[3] found 70 to 100 per cent. of children with enlarged glands; of these, he estimated 32 to 58 per cent. were tuberculous. Volland[4] gave 94 per cent. as the number of children with enlarged glands.

It would appear that the tonsil subtracts a certain number of bacteria from the food and air, while the adenoids are bathed in the secretion of the nose. Owing to the sponge-work structure of the first, and the anatomical protection of the other, every opportunity for septic absorption is provided. It is obvious that the tonsil can subtract only

[1] Harbitz: Quoted from *Journal of Infectious Diseases*, ii., p. 143. Chicago, 1905.
[2] Oehlecher: "Tuberculose Arbeiten aus den Kaiserlichen Gesundheitsamte," vi. 1907.
[3] Laser: *Deutsche Med. Wochenschrift*, xxii., p. 500. 1896.
[4] Volland: *Zeits. f. Klin. Med.*, xxiii., p. 50. 1893.

a tithe of the bacteria present, so the tonsil cannot be said to act as a barrier, except in so far as the whole lymph system functions as such; while even if the salivary corpuscles do act as carriers of bacteria, these can hardly so scavenge the whole mouth and naso-pharynx. It is probable that by the entry of bacilli the lymph system is kept in bacteriological *rapport* with the bacteria in the mouth and food; in fact, the lymphoid tissue acts as a taster, to continue a metaphor from Sir A. E. Wright, and so provides material for the acquirement of protection in the opsonin laboratory. Tonsils and adenoids are the first large collection of lymphoid tissue met by air and food. It would appear that, with the exception of some lymphoid tissue in the pharyngeal and œsophageal wall, some time elapses before bacteria, if they escape the action of the gastric juice, come into the same close contact with lymphoid tissues. The functions of tonsils and adenoids appear to be vicariously performed by other lymphoid tissue, so that it is quite possible that freedom from attrition determines the special growth of tonsils and adenoids. It is impossible to say whether strain of bacteria, or number, or diminished resistance, plays the more important rôle in deciding whether Class 1, 2, or 3 gland results or destruction of the bacilli. Lack[1] states that a chain of shotty glands at the posterior margin of the sterno-mastoid is almost pathognomonic of adenoids. The deep cervical gland on a level with the tonsil is most often enlarged in the presence of septic tonsils and adenoids. It is from this point that the glands enlarge centrally and laterally. I have operated on some thousands of such cases, and have never seen a case, subsequent to operation, develop glands of Class 1 or 2, though frequently the previous appearance suggested Class 2. After suitable treatment of the nose and throat, combined with general treatment, these glands shrivel to the size and substance of a small hard nut. Blumenfeld states that a visit to a health resort is of advantage only when such operation has been carried out. It is clear that removal of adenoids and tonsils does check the formation of definite tubercle in the cervical glands; whether due to diminished invasion, improved health, or less septic absorption is uncertain. It is probable that in febrile states bacilli pass to the bronchial glands.

Teeth may give rise to enlarged submental and submaxillary glands, but not so commonly in young children as in adults; but by increasing the sepsis of the mouth teeth may cause tonsillar trouble. Dr. Guthrie informs me that there is increasing evidence of the variable size of the bronchial glands in phases of disease.

[1] Lack, Lambert: "Diseases of the Nose." London, 1906.

Nasal Tuberculous Infection.

K. Renshaw[1] has discussed the possible routes of lymphatic extension after tuberculous infection of the nose: (1) Through the cribriform plate to the meninges. In support of this, Demme[2] relates a case of ulceration of the nose and death from tuberculous meningitis. (2) Direct to the lungs and larynx. (3) Through the cervical lymphatic system to the bronchial glands. Renshaw injected, without apparently causing damage to the mucous membrane, solid and liquid sputum from tuberculous patients into eight guinea-pigs' noses. Seven died with tuberculous glands, and later lung involvement. In all these fatal cases there was ulceration of the nose. The conditions of Renshaw's experiments are different from those obtaining under normal conditions, such as were produced in the Charité experiments. Thomson and Hewlett[3] found the normal nose sterile in 80 per cent. of instances. Lucas[4] examined swabs from the nose of fifty consumptives; 80 per cent. contained bacteria, but only one tubercle bacilli. In rhinitis sicca and other forms of rhinitis organisms are present. In every case of facial erysipelas I have had the opportunity of examining, rhinitis sicca has been present. In such abnormal conditions tuberculous infection could take place with insignificant local symptoms. Willigk,[5] in 476 autopsies on phthisical bodies, found only one case of ulceration of the nose, a condition which appertained to all Renshaw's experimental cases. It would thus seem that tubercle bacilli entering the nose are usually removed by the mucous secretion, which is swallowed by the child. In certain abnormal conditions probably bacilli enter and pass into the cervical lymphatic system.

Clinical Forms of Naso-pharyngeal Tuberculosis and Treatment.

Tuberculosis of the nasal cavities in children may take the form of (1) moist hypertrophic granulations, (2) dry ulceration, (3) tuberculoma, (4) solitary ulcer.

Lupus.—In Christiansen's cases of lupus the nose was infected in three-quarters of the total number. The anterior part of the septum is usually attacked, and next in frequency the inferior turbinal. In a moist nose the first form is seen, and in dry noses the second or dry ulceration appears. In some patients one form passes into the other as the condition of the nose varies. Large, moist, pale granulations appearing in crops characterize the first form, while a dry, crusted, and

[1] Renshaw, K.: *Journal of Pathology and Bacteriology*, vii., p. 142. 1901.
[2] Demme; *Berlin. Klin. Wochenschrift*, xv., S. 217. 1883.
[3] Thomson, St. Clair, and Hewlett: *Journal of Laryngology*, ix. 1895.
[4] Quoted by Lake and Barwell: "Laryngeal Phthisis." London, 1905.
[5] Willigk: *Vrljsch. f. d. Prachthoilkund*, Bd. xxxviii., S. 1. Prag., 1853.

eroded surface is presented in the second. If the disease is allowed to extend, the cartilage of the nose becomes involved, resulting in the well-known deformity.

In treating lupus of this region the nose is usually scraped, preferably with Meyer's ring-knife under a general anæsthetic, and then a caustic, such as silver nitrate or chromic acid, is applied. A second scraping when necessary may be well carried out under local anæsthesia. Both in this and in the above-described manipulation suprarenal extract may be used to restrain bleeding and enable more accurate manipulation to be carried out. Before dealing with a dry form it is well to improve the nose to a moist condition by spraying with 10 vol. hydrogen peroxide solution, packing with cyanide gauze, and applying dilute mercury nitrate oil. As in all nasal work, the nose must never be allowed to become dry. Lack recommends the internal use of arsenic. I have seen some good results from light treatment in early stages. Subsequent to either operative or light treatment, the above-described local treatment must be persevered with; I have found hydrogen peroxide decidedly efficacious.

Nasal Tuberculoma.—This usually appears as a smooth, pale, or red tumour, which may grow from a previously existing ulcer, or may become eventually ulcerated. According to Lack, it occurs mostly in association with pulmonary tuberculosis, but it may be primary. Treatment necessitates removal, which is effected either with snare or ring-knife, and the base cauterized as described in the section on lupus.

Tuberculous Ulceration.—The rare solitary tuberculous ulcer found at the posterior part of the nose is due to secondary infection from the lungs. Parker reports a case of turbinectomy in unsuspected pulmonary tuberculosis, which resulted in infection of the wound.

The pharynx, where nasal and tracheal mucus mingle with food, is very rarely the seat of primary tuberculosis. Walsham records one such case in an adult. There is a rare form of miliary tuberculosis in which discrete white spots appear surrounded with a pink zone passing on to ulceration.

Of the two secondary forms of tuberculous infection, the first is only recognized microscopically in the plaques of lymphoid tissue on the pharyngeal wall. Sokolowski removed these granules from thirty-four cases of pulmonary tuberculosis, and found all to be tuberculous. The more serious and rarer form of secondary involvement is extensive ulceration. The ulcer is superficial, with a pale tuberculous base and inflamed margin. It is seen in advanced cases, and is usually, according to Barwell,[1] premonitory of the end. Blumenfeld states that he has known such cases improve under local antiseptic treatment. I have

[1] Barwell, H.: "Throat and Nose in Relation to Phthisis," *Practitioner*, June, 1906.

employed local applications and frictions of hydrogen peroxide with some success.

The adenoid ring comprising adenoids, tonsils, and lingual tonsils, provides a frequent entry for tuberculous infection, and is commonly the seat of a local primary infection, which, however, usually takes the form of microscopic tubercle, showing the presence of latent tubercle bacilli. Lewin records tuberculous infection 45 times in 905 cases collected from various sources. Trautmann regarded many adenoids as tuberculous. Blumenfeld says adenoids are usually present in the children of tuberculous parents, but recognizes the entity of adenoids as a separate pathological state. Lane considers that adenoids are the result of sepsis and catarrh. Macdonald and Parker take the view that lepto-prosopia is a very important factor.

Adenoids are to be regarded as the excessive development of lymphoid tissue normally present, which usually become obvious at the age of one and a half to three years, and are due to a chronic septic pharyngitis. Several conditions contribute to this hypertrophy—viz., (1) absence of mechanical trituration consequent on the anatomical structure of the naso-pharynx; (2) nasal obstruction, common alike to defective cleansing, rickets, and lepto-prosopia; (3) liability to catarrh and sepsis, so common in rickets, lymphatism, and tuberculous stock; (4) dyspepsia and atmospheric conditions conduce to the development of adenoids. J. Sim Wallace[1] has written on this point. He considers much dyspepsia to be due to feeding children on soft food. The tongue becomes feeble from disuse and mouth-breathing, so that the alveoli of the upper jaw are not pushed out. Nasal obstruction results, and adenoids. Further, Wallace considers that adenoids are due to the windows of the sleeping room being open in bad and damp weather. (Out of sixty-nine who slept with closed windows in the Thames Valley, two cases of adenoids were found, while out of forty-nine who slept with open windows at night, twenty-two cases occurred.)

The particular conditions which favour chronic rhinitis, adenoiditis, and tonsillitis, are a rapidly changing climate, such as cold, damp nights, followed by warm, dusty days. If adenoids are examined under these conditions they will be found to be twice the size. Cold air has at first an irritating effect on the nose, causing swelling and a deposition of fluid, partly due to increased secretion and partly to precipitation of moisture on the warm air coming into contact with cold. Gradually, however, the nose becomes accustomed to the cold air, particularly in adults; the mucous membrane shrinks, and nasal breathing is established. This is seen in the open-air treatment of consumption. Heat and dust also cause irritation of the nose. In this way the air by the

[1] Wallace, J. Sim: "Open Windows and Adenoids," *Medical Press*, p. 373, 1908; "Nasal Obstruction and Mouth-Breathing," *Medical Press*, 1905.

sea has come to be recognized as beneficial in these cases; for the temperature varies but little, and the humidity of the air is never excessive, and contains a little salt. The East Coast in summer and the Folkestone district in winter are the most suitable for this purpose in England. On the other hand, good results are obtained in dry districts at an altitude of 300 to 400 feet.

Holt[1] points out that children with adenoids contract diphtheria and tubercle more easily than others, and that attacks of diphtheria and scarlet fever are more severe under these conditions. Schlesinger[2] suggested the possibility of retrograde infection from the sputum and lymph glands. Dieulefoy[3] and Ponfick[4] consider that primary infection occurs in adenoids. Recently Lartigan and Nicoll, in an examination of seventy-five cases, found tubercle in 10 per cent., and tubercle bacilli in another 6 per cent.; staphylococci and streptococci were recognized in five out of eleven cases; the bacteria appeared beneath the epithelium of the crypts.

Walsham describes two primary cases of tuberculosis of the tonsil in the adult. Secondary infection of the tonsil is extremely common in tuberculous patients; it was recognized post-mortem by Walsham twenty-one times in thirty-six cases of phthisis in adults. It is seen, as a rule, only on microscopical examination. Secondary ulceration, as in the pharynx, is rare.

Adenoids and tonsils should be removed, especially in the children of tuberculous patients, when giving rise to any symptoms. This becomes absolutely essential when prophylactic treatment has failed.

Secondary ulceration is treated on the lines detailed under pharyngeal ulceration.

Functions of the Healthy Naso-Pharynx in Childhood.

The function of the normal nose is: (1) To warm the air. Kayser[5] found the air ½° C. warmer after passing through the nose. (2) To saturate the air with moisture; this function mostly depends on the vascular inferior turbinal. It is obvious that the warmer air in alveoli contains more water vapour. (3) To remove dust and solid particles. St. Clair Thomson and Hewlett found the mucous membrane of the nose sterile in 80 per cent. of cases.

Mucus containing any dust or bacteria is swept into the naso-pharynx to be swallowed by the child, with the result that children

[1] Holt, L. E.: "The Diseases of Infancy and Childhood." London, 1907.
[2] Schlesinger: "Tuberculose der tonsille bei Kindern," *Berlin Klinik.*, September, 1896.
[3] Dieulefoy: *Mercredi Médicale*, No. 9, 1895.
[4] Ponfick: "Uber die Beziehungen der Scrofulose zur Tuberculose," *Jahrbuch für Kinderheilkunde*, Bd. liii., 1. 1901.
[5] Kayser: *Archiv f. Physiologie*, Bd. xli., S. 127. 1887.

swallow the sum total of air- and food-borne virus. In the adult this material is either expelled or swept from the nose or mouth.

The nose fails in its function (1) in cases of nasal obstruction; (2) when the nose is too patent, as in the case of ozæna or atrophic catarrh.

In normal breathing, Parker[1] found the inspired air passed up along the septum through the middle and superior meatus to impinge on the roof of the naso-pharynx. Lycopodium powder was used to give inspiratory patterns, while smoke gave the expiratory course as it passed along the inferior meatus. Accordingly inspiration can be obstructed by collapse of the alæ nasi, columellar projections, septal spurs or deflections, an enlarged anterior end of the inferior turbinal bone, the body or anterior cell of the middle turbinal, posterior end of the inferior turbinal, and a central mass of adenoids, especially if the mass is low down or swollen by catarrh. The expiratory blast will be diminished by contracted orifices and any enlarged part of the inferior turbinal or adenoids. When a child is asleep on the right side the left nostril is alone used for respiration; meanwhile, the mucous membrane of the lower nostril recovers. It is essential that the individual should utilize both sides of the nose, otherwise rhinitis sicca or atrophic rhinitis appears in the too patent side, while chronic rhinitis adds to the trouble of the narrow nostril. It is also advisable in treating cases to allow the inspiratory blast to take the normal course, and that the inferior meatus should not be utilized alike for inspiration and expiration.

Nasal Catarrh and Tuberculous Infection:

All observers are agreed that catarrhal processes tend to the local invasion of tubercle bacilli by either lymphatic, blood, or epithelial infection. The tonsils are extremely prone to catarrh, as mentioned above, and adenoids to a less degree. The catarrhal laryngitis of phthisis is due partly to nasal obstruction and also to the effect of cough. Herzog shows that the more bacilli enter, the greater the chance of local ulceration. The maximum points of stress during coughing are probably the larynx and the apices of the lungs.

The examination of the noses of many patients who have undergone open-air treatment shows that in the larger number of cases nasal breathing has been re-established by the open-air treatment. It is impossible to severally apportion the influence of improved hygiene, aeration feeding, nasal breathing, and regulated life, in arriving at the good results obtained by this treatment; but not sufficient of this improvement has been attributed to nasal breathing.

Systematic exercises are of great importance in improving the

[1] Parker, C. A.: *Journal of Laryngology*, p. 345. 1901.

breathing powers of children. A simple series consists of the following: (1) Raise the arms from the sides to the front, straight out in line with the shoulders (first movement), and then above the head (second movement). Both movements are carried out during slow nasal inspiration. Allow the arms to drop to the sides with sharp buccal expiration (third movement). (2) Hold the arms straight out laterally from the shoulders, with elbows flexed. Draw forearms sharply out at a right angle (first movement), and then (second movement) fully extend in line with the arm. Inspire slowly through the nose during these two movements. Bring the arm back to the first position, expiring sharply through the mouth. (3) Swing the arms above the head during slow and deep nasal inspiration. Expire sharply through the mouth as the arms fall to the sides. (4) Stand with hands on floating ribs; alternately expand and contract the chest to the extreme, breathing slowly in and out through the nose. The hands assist the movement of the ribs.

Some of these exercises may be carried out when lying down back to floor. In many children the carrying out of such breathing exercises will do much to lessen a predisposition to tuberculosis.

In a consideration of nasal and pharyngeal catarrh, it must be observed that sepsis and vaso-motor changes bear no definite proportion. In some cases, as in rheumatic catarrh and hay-fever conditions, the vaso-motor change is especially pronounced, while septic absorption is reduced to a minimum. An obstructed nose means septic absorption in an increased degree, producing local œdema and collection of secretion. The effect of syringing or open-air treatment is to some extent the same; both cause a vaso-constriction of the mucous membrane, and remove secretion. This result is particularly well seen in those cases of mild sepsis or vaso-motor change called chronic rhinitis. The cough of consumptives who suffer with chronic rhinitis is relieved at once if treated on these lines. The cough depends in a degree on the mouth-breathing present, apart from the question of quality of air, in addition to the lung condition.

Nasal Obstruction in Childhood and Predisposition to Tuberculosis.

When the nose is obstructed, instead of the child's respiration when asleep consisting of noiseless inspiration followed by a sharp expiration, both are prolonged and noisy. In marked cases the child frequently arouses to take several breaths through the mouth. In adults the palate flaps (snoring) as air passes inwards through the nose and mouth; while towards the end of an inspiration the tongue comes in contact with the palate, to be again parted by the expiratory blast.

The results of nasal obstruction in the growing child are: (1) Nasal

deformities; (2) catarrh of the upper and lower respiratory tract; (3) defective respiration, and consequent depreciation; (4) defective development of the chest.

Lack has demonstrated how the upper jaw is, so to speak, compressed in the region of the first molars, producing a V-shaped jaw, open bite, oblique alveoli and teeth, high palate, and compressed and distorted septum. The lower jaw in less degree presents a similar deformity. Lane considers that the size of the lower jaw depends on the development of the tongue. Lack observes that the pressure of the muscles on the open jaws, combined with the want of muscular opposition of the alveoli, determines this condition. In support of this view it is to be noted that in open bite the palate is relatively higher anteriorly. I have noticed that septal deflection in children commences at the anterior part of the nose; thus the maximum defect is anterior, while the molars are in contact posteriorly. Narrowness of the anterior and posterior nares, chronic rhinitis, hypertrophic rhinitis, all follow this primary obstruction.

The common cause of nasal obstruction is adenoid growths. These develop at an early age, and usually shrivel at the age of fifteen, when the pharynx rapidly increases in capacity. By this time the architecture of the nose is nearly complete, so that nasal deformity and chronic rhinitis remain as well as the allied chest deformity. Even in the third decennium, treatment of the obstruction results in improved chest shape and capacity (Blumenfeld). The so-called congenital adenoid appears in the first few weeks of life, either in association with, or as the result of, a nasal catarrh. At this stage a curette brings away several small nodules. The catarrh when treated may disappear in a few weeks' time; but if the catarrh is persistent, or symptoms of nasal obstruction are present, a curette will bring away an adenoid mass the size of a pea or a diffuse mass (æt. six weeks). Lane regards adenoids as the result of catarrh. Siebenmann[1] considers that nasal obstruction is due to the inheritance of lepto-prosopia. It must be admitted that both these are factors in the appearance and enlargement of adenoid tissue.

I have already endeavoured to show that the catarrhal condition of the upper respiratory tract consequent on nasal obstruction renders the tissues more liable to tuberculous infection. To defective aeration is said to be due the anæmia and indifferent health so often associated with nasal obstruction. It is difficult to say how much of this is due to direct interference with lung functions, and how much to septic absorption. In this connection the excellent effect on corneal ulcer of the removal of adenoids may be noted. This fact has been pointed out to me by Mr. Arnold Lawson and Mr. Stephen Mayou.

The chest deformities of nasal obstruction are identical with the

[1] Siebenmann: *Münch. Med. Wochenschrift*, xliv., p. 983, 1897.

phthisical chest—*e.g.*, the long flat chest with winged scapulæ (Hippocratic chest). The deformity is much more pronounced if rickets is associated (in Baldwin's[1] cases of phthisis, 3 per cent. were rickety); in this event pigeon-chest and Hutchinson's lines are well marked. In non-rickety patients the lower end of the sternum is drawn in, and forms a pit (Lack). It is interesting to remark that of the two recognized consumptive types of individual, the delicate type is that usually associated with a narrow nose, and the coarse type with hypertrophic rhinitis.

The Association of Intra-nasal Defects with Pulmonary Tuberculosis.

There are no observations available as to the association of intra-nasal defects in children with pulmonary disease, but the treatment or prevention of such defects belongs usually to the age of childhood. If we would secure wise prophylactic measures for the protection of childhood it is necessary to study the frequency and influences of untreated naso-pharyngeal defects in adults on the development, progress, and treatment of cases of pulmonary tuberculosis. Comparison with non-phthisical adults is not discussed here, but the prevalence of such conditions which tend to increase forms of naso-respiratory catarrh is particularly important.

To Jarvis[2] belongs the credit of first noticing the association of intra-nasal defects with pulmonary tuberculosis. Solly[3] and Clark[4] showed the high percentage of these deformities, and suggested treatment on surgical lines. Alexander[5] examined 200 cases of phthisis, and found ozæna and atrophic rhinitis in 16 per cent. In eighty cases, besides septal deformities, there were 60 per cent. with other nasal abnormalities. Moeller and Rappoport,[6] in 120 sanatorium cases, found 84 per cent. of nasal abnormalities; they urge the importance of rhinological treatment. Moure[7] described an atrophic rhinitis hereditary in tuberculous subjects. Rivers[8] confirmed many of these observations; he considers the definite relation of pulmonary tuberculosis and nasal obstruction proved, and that the aerial bacilli are swallowed, and increase the chances of intestinal infection. I have recently examined forty-three cases of pulmonary tuberculosis indiscriminately selected as they attended at the out-patient department of Mount Vernon Hospital,

[1] Baldwin: "Osler's System of Medicine." London. 1908.
[2] Jarvis: *New York Medical Journal*, September, 1885.
[3] Solly, J.: American Medical Association, September, 1894.
[4] Clark: *Boston Medical and Surgical Journal*, October, 1895.
[5] Alexander: *Archiv f. Laryngologie*, Bd. xiv., Heft 1. 1903.
[6] Moeller and Rappoport: *Zeits. f. Tuberculose*, Bd. iv., Heft 5, S. 417. 1903.
[7] Moure: *Revue Hebdomadaire de Laryngologie*, October. 1903.
[8] Rivers: "Non-tuberculous Intra-nasal and Post-nasal Abnormalities," *Lancet*, p. 1820. 1907.

thanks to the courtesy of Dr. Frederick W. Price. It is difficult to establish a criterion of free inspiration or expiration, except that inspiration is almost noiseless, and there is no mouth-breathing at night. I divided them into four classes on this basis: (1) Free inspiration and expiration, four cases; (2) slight nasal obstruction, such as would certainly be relieved by open-air treatment or lotions (in a less degree), eight cases; (3) cases intermediate between 2 and 4, fifteen cases; (4) cases with a degree of nasal obstruction, which would be treated operatively with benefit if the patients applied at a rhinological department for relief, with sound chests, sixteen cases. In five the obstruction was one-sided.

Atrophic Rhinitis and Tuberculosis.

In patients with wide nares, as in atrophic rhinitis, the nasal function is also in abeyance. Such cases run in families, though many members may have narrow or normal noses. In atrophic rhinitis, besides the septic crusts in the nose and pharynx, the trachea is affected to a considerable extent. Of Lack's 150 cases, only two were phthisical. In England, ozæna, according to Barwell, is uncommon in hospitals for consumption. Of fifty cases of ozæna, Alexander found seventeen only without signs of phthisis; there were, however, some points of peculiarity about the accompanying acid-fast bacilli in many of the cases. Wingrave found a tuberculous history in thirty-seven out of sixty cases of ozæna. Lack says that ozæna predisposes to phthisis and other lung affections. In this connection attention may be called to chronic lung trouble which is due to suppurating sinuses. Kirkland describes three cases of bronchitis and bronchiectasis, which improved on treatment of suppurating antra. Lack records how several cases of circumscribed pneumococcal pneumonia have cleared up on treating antra which were suppurating.

Some cases of one-sided atrophic catarrh are relieved by treatment of the deflected septum, according to Parker.[1] This I can confirm. It is probable that in this condition another secondary product of early nasal obstruction is contributing to lung disease. Blumenfeld adds another predisposing cause, viz., the atrophic catarrh of diabetes. The tendency of all diabetics to infection must be taken into account.

General Prophylaxis.

Prophylactic treatment should be undertaken in the home and in the school. In the domestic circle no person suffering with tuberculosis should be allowed to live with, or attend on, children. The sleeping and living apartments should have plenty of air and sunlight. Fresh air must be admitted by windows in good weather, and from doors in indifferent or bad weather. Dust is to be avoided, and all harbourers of dust—

[1] Parker, C. A.: *Clinical Journal.* 1907.

i.e., stuffed furniture, etc.—should be removed. The floors should be non-absorbent, or covered with linoleum, and the few rugs necessary shaken frequently. Special care in feeding is to be taken to avoid rickets, and plenty of butter or emulsified fats must be freely given. Milch cows should be tested with tuberculin and certified. In the absence of such test all milk should be pasteurized.

Breathing exercises should be employed either at home or in the school at an early age, and the use of the handkerchief to clear either nostril insisted on.

In small children the nose should be cleansed in the morning with a swab of wool soaked in boracic lotion. The promiscuous sucking of comforters and other things must be stopped. The bowels should be regulated, and teeth attended to. In the matter of clothing it is important to avoid overloading as well as underdressing. Thick boots should be used in wet weather.

The child should be washed twice a day, and towels reserved. At the school the same general principles should be carried out. The indiscriminate use of schoolrooms by adults is to be deprecated. Medical inspection of teachers and children should be compulsory, and especial attention directed to the nose, throat, mouth, glands, and lungs. Open fires should be used, and the air kept sufficiently moist. Open-air schools should be instituted for the weakly, and those with a marked consumptive history; an alternative room, suitably arranged for bad weather, is an essential addition. Children who are definitely tuberculous require to be removed to special schools. Tuberculosis in any form should be a notifiable disease, to be isolated where possible.

Medical and Surgical Treatment.

In the early days of infant life the nose requires to be cleansed with a screw of lint or wool moistened with boric acid lotion. This treatment produces a constrictor effect on the nose and removes secretion. If there is a definite catarrh, I apply ℞ ung. ol. hydrarg. ʒss., ol. amygdal., paroleine āā ad ʒi., as ointment, paint, or spray to the anterior nares. The child takes every night ℞ hyd. c. cret., sodii salicylatis āā gr. ss., sodii bicarb. gr. ii., ft. pulv. Syphilis or rickets, as well as other dyscrasia, are to be suitably treated. If at the end of a month nasal breathing is not obtained, and non-specific catarrh remains unabated, adenoids are probably present. A small Beekman curette is passed into the post-nasal space and the growths removed. If at any later time the child develops nasal obstruction, frequent catarrh, enlarged glands, aural catarrh, or any other symptom due to adenoids or chronic tonsillitis, particularly if there is a tuberculous history, it will be well to remove the adenoids and tonsils. Mackenzie's guillotine, if two cuts are made, is quite efficient in most cases. Chiari advises removal of

the whole tonsil by dissection if histological examination reveals tubercle. Blumenfeld recommends dissection in all cases from the very first, especially if there is a tuberculous history. It appears to me that this is only necessary when the anterior pillar is unusually prominent and conceals the tonsil. In these cases there is often a well-developed supra-tonsillar fossa, and peri-tonsillitis sets in later. The long, flat tonsil is also conveniently removed in this way. Adenoids are best dealt with by a Thomson curette, or a pattern I have designed to obviate damage to the mucous membrane; the region in the neighbourhood of the Eustachian tube is carefully scraped with a Meyer's ring-knife. The operation, to be complete, should be carried out under narcosis. An examination of the posterior nares should be made with the finger. Children of nine months and upwards should be strapped in a special chair. I find ethyl chloride a satisfactory anæsthetic. The head of the patient is tilted forward between the manipulations. In the sitting position the little patients are rarely frightened, and lose little blood. In the prone position A.C.E. or CE_2 answers well; the patient is rolled over on the side between the cuts, or the whole operation is carried out in the lateral position. Occasionally in these smaller children there is a slight projection of the columella nasi which interferes with breathing. This may be removed with fixation forceps and knife. A swollen anterior end of the inferior turbinal is occasionally seen in contact with the septum; the more prominent of these should be treated by scissors and snare (Lake's method), or scissors and spokeshave, so that only the anterior end is removed. It is advisable to confer equal breathing capacity on either side; this is effected by early removal of the cause of nasal obstruction and equalizing the nares as occasion arises.

About the age of eight commencing deflections threaten the nose; in the more marked cases the cartilaginous spur may be removed with tenaculum forceps and knife, or—the later the better, consistent with removal of the obstructions—a small submucous resection is carried out. After fifteen years of age normal mucous membrane has an increasing tendency to diminish in bulk, a change which adenoids and tonsils also take part in. On examining such a nose it is necessary to test separately the powers of inspiration and expiration of either nostril; in most cases it is a matter of estimating whether inspiration is sufficient. If not sufficient, the nose is carefully examined—first the anterior nares, and then the posterior nares and naso-pharynx, to locate the obstructing part. If necessary, a spray of 5 per cent. cocain and a probe will differentiate between simple rhinitis and hypertrophic rhinitis and bone. Simple rhinitis is treated by ℞ sod., bicarb., chlorid., bibor. āā ʒi.; ʒi. ad Oi. aq. calid. Ft. coll. ℞ Cocain 2 gr., menthol 5 gr.-15 gr., paroleine ad ʒi., as a spray, is also useful.

Anæmia, constipation, and dyspepsia must also be treated; calomel, gr. ss., or hyd. c. cret., 1 gr. twice a week, is useful. If obstruction is more severe, then the obstructing parts are dealt with seriatim. Columellæ projections and small cartilaginous obstructions are treated as above.

Collapse of the alæ nasi is remedied in this way, or an instrument is employed (as devised by Junkau, Brindel, or Francis), though it is rarely tolerated for any length of time. Lack's plastic operation is carried out in extreme instances. Submucous resection sometimes gives the required relief. Removal of the anterior end of the inferior turbinal will open up the middle and inferior meatus. This can be effected with scissors and snare (Lake), or scissors, Ballenger's cutting-forceps, or Luc's forceps. Obstruction due to the middle turbinal may require treatment. An anterior end expanded by a cyst in a wide nostril should be treated by biting off the anterior end with Luc's forceps. In a narrow nose it is better to remove the whole of the middle turbinal with a spokeshave, as adhesions or suppuration readily attacks this region.

With regard to after-treatment, packing is necessary in submucous resections to keep the two flaps together and obviate the formation of a hæmatoma. If the nose is narrow, and adhesions are feared, a thin rubber splint retained for two to three days gives excellent drainage. The lotion and spray suggested under the treatment of chronic rhinitis may be employed on the day after the operation. Before these operations, the face, teeth, and mouth should be prepared, and all lotions, syringes, and oils sterilized. Tr. calendulæ (℥i. ad Oss. aq. calid.) makes an excellent mouth-wash.

While the importance of fresh air and freedom from dust, particularly dusty floors, cannot be overestimated, yet children, when suffering from catarrhs, or when a degree of nasal obstruction is present to an extent which precludes nasal breathing, must be more gently treated, or, better still, the nasal conditions improved by operation.

VIII.

LARYNGEAL TUBERCULOSIS IN CHILDREN.

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In tuberculosis of the larynx it may be stated generally that the infection may be brought about in four ways, or, rather, from four different sources:

1. *Primary Laryngeal Tuberculosis.*—Cases in which the tubercle bacilli are inhaled and effect an entrance directly into the laryngeal tissues from the surface, and are not derived from any previously existing disease within the body. This condition is very rare, but a sufficient number of cases have been investigated post-mortem to prove undoubtedly that it does occasionally occur.

2. *Cases Secondary to Disease above the Larynx.*—The most important focus of disease under this heading is the middle ear, and cases have been recorded in which, after an apparently primary tuberculous otitis media, the larynx has become involved secondarily. In such cases the larynx must be infected directly by the discharge poured out from the Eustachian tube.

3. *Miliary Tuberculosis.*—The larynx may be affected as part of a general miliary tuberculous infection, the bacilli being carried to the organ by the blood-stream. In these cases, which occur most frequently in children, the local disease is overshadowed by the serious symptoms produced by the invasion of other organs, and is of little practical clinical importance.

4. *Cases Secondary to Pulmonary Phthisis.*—Finally, in the overwhelming majority of instances, tuberculous laryngitis is secondary to pulmonary tuberculosis. The bacilli enter through the surface, and are conveyed to the larynx by the sputum.

Frequency and Localization.

It may be said at once that laryngeal tuberculosis in early childhood is excessively rare, though it is no longer so very uncommon after the age of ten to twelve years.[1] A few cases of its occurrence in infancy have been recorded; they have usually been cases of generalized tuberculosis with lesions in nearly every organ of the body, or else due to some uncommon mode of infection, and not, as is usual in adult life, a complication of ordinary pulmonary phthisis. In the majority of cases occurring in early childhood the laryngeal lesion has only been definitely diagnosed at the autopsy.

The following cases of tuberculous laryngitis occurring in infancy have been recorded: Heinze[2] found three cases post-mortem in a very large experience of autopsies—one a boy eleven months of age, one a girl aged twelve months, and the third a boy of fifteen months, all with extensively generalized tuberculosis. Jobson Horne[3] has exhibited a larynx from a child aged twelve months, sex not stated, who had died from pulmonary tuberculosis; giant cells and tubercle bacilli were found in an excrescence on the inter-arytenoid region and in the outer wall of the left ventricle. Rheindorff[4] gives the clinical report of a girl who died, aged thirteen months, of generalized tuberculosis; she was the subject of congenital syphilis, had been hoarse for five months before death, and had suffered from cough and pulmonary catarrh for two months. Attempts at inspection during life were unsuccessful, but at the post-mortem examination an ulcer was found which had destroyed the right cord and ventricular band.

The rarity, however, of laryngeal tuberculosis in early childhood may best be made clear by quoting the experience of those who have had the opportunity of examining large numbers of cases of laryngeal disease. Thus the youngest patient seen by Moritz Schmidt[5] was a girl aged eleven. Froebelius[6] reported that in ten years at the Foundling Hospital in St. Petersburg 91,370 infants were attended to, 18,569 died, and autopsies were performed on 16,581; of these, 416 showed signs of tuberculosis and 10 had laryngeal ulceration. Demme,[7] out of 36,148 child patients examined over a period of

[1] Rauchfuss, C.: "Krankheiten des Kehlkopfes und der Luftröhre." Gerhardt's "Handbuch der Kinderkrankheiten," B. iii., 2, § 248. Tübingen, 1878.

[2] Heinze, O.: "Die Kehlkopfschwindsucht." Leipzig, 1879.

[3] Horne, J.: Proceedings of the Laryngological Society of London, January, 1900.

[4] Rheindorff, H.: "Ueber Kehlkopftuberculose im Kindesalter," *Jahrbuch für Kinderheilkunde*, B. xxxiii., § 71. Leipzig, 1892.

[5] Schmidt, M.: "Die Kehlkopfschwindsucht," *Deutsches Archiv für klinische Medicin*, B. xxvi., § 325. Leipzig, 1880.

[6] Froebelius, W.: "Ueber die Häufigkeit der Tuberculosis," *Jahrbuch für Kinderheilkunde*, B. xxiv., § 47. Leipzig, 1886.

[7] Demme, R.: "Medizinische Berichte über die Thätigkeit des Jenner'schen Kinderspitals in Bern im jahre, 1882." Bern, 1883.

twenty years, saw eight cases of tuberculous laryngitis—five boys, from four to eight years of age, and three girls, aged respectively two and a half, four, and twelve. In all cases, with one exception, the laryngeal disease was a complication of pulmonary tuberculosis, and showed itself but a few weeks before death. The exception is remarkable in that it is one of the very few in which the occurrence of tuberculous laryngitis has been definitely proved by post-mortem examination to be present as a primary affection, or, rather, without the coexistence of any tuberculous lesion in the lungs. In this case —a boy, aged four and a half years—a hypertrophied left tonsil was removed, the retro-maxillary glands became swollen, and the patient finally died of basal meningitis. An ulcer was found at the autopsy in the inter-arytenoid region extending on to the right vocal cord. Demme recognized the laryngeal condition during life, and considered that the lymph paths, opened up by the tonsillotomy, gave entrance to the tubercle bacilli, which then reached the larynx by the same route. Another explanation would appear equally possible, and more in accordance with the usual method of infection of the larynx—namely, that the discharges from the tuberculous tonsil passed down the pharynx, and that the infection of the larynx took place from the surface.

An analysis of a large number of cases shows that laryngeal tuberculosis is most common between the ages of twenty and forty, and is very rare below the age of ten. Pulmonary phthisis is also most frequent during the third and fourth decades; but this alone does not suffice to explain the preponderance, for the actual proportion of consumptives attacked by tuberculous laryngitis is considerably higher in these two decades than for any other age-period, and becomes progressively smaller at the earlier periods of life.

The following figures[1] show the age-incidence of 605 cases of tuberculous larynx:

TABLE INDICATING THE AGE-INCIDENCE OF TUBERCULOSIS OF THE LARYNX.

Age.	Number of Cases.	Percentage.
1–10	3	0·496
11–20	100	16·53
21–30	252	41·65
31–40	165	27·27
41–50	64	10·58
51 and upwards	21	3·47

[1] Lake, R., and Barwell, H.: "Laryngeal Phthisis," second edition. London, 1905.

These figures also show that in the late period of childhood the disease is not very uncommon. The next table (deduced from Heinze's figures) shows how, among consumptives, the incidence of the laryngeal complication varies with the age:

TABLE SHOWING THE ASSOCIATION OF LARYNGEAL TUBERCULOSIS WITH PULMONARY TUBERCULOSIS AT DIFFERENT AGES.

Age.	Pulmonary Tuberculosis.	Laryngeal Tuberculous Ulceration.	Percentage of Laryngeal Cases.
Under 1 year	13	1	7·7
1–10	39	4	10·25
11–20	92	23	25·0
21–30	406	130	32·0
31–40	303	112	36·96
41–50	179	67	37·43
51–60	104	27	25·96
61–70	53	9	17·17

Ætiological Factors.

Thus it is plain that some other factors are needed to explain the rarity of the laryngeal disease at an early age beside the comparative infrequency of the pulmonary affection. These reasons are not far to seek:

1. The progress of pulmonary tuberculosis in children is a rapid one, and gives but little time for the larynx to become infected.

2. The generalized form of tuberculosis is common in childhood, while the ordinary adult form of ulcerative phthisis is comparatively rare; but miliary tuberculosis is hardly accompanied by sputum, so that infection of the larynx is not likely to occur.

3. Such predisposing causes as previous laryngeal disease are absent. A significant fact is that, among the reports of the occurrence of the disease in childhood, some of which I have mentioned, very few are records of clinical observation; in fact, most of the reported cases have been discovered at post-mortem examinations. Morell Mackenzie[1] found that, among 500 cases examined clinically, only one patient was under fifteen years of age; whilst of 100 cases seen post-mortem, one was under ten and four were under fifteen years. It would therefore appear that the disease often escapes observation during life, and, as the larynx is not always thoroughly examined at autopsies, it is probable that the affection is somewhat more common than the published records would lead one to suppose.

[1] Mackenzie, M.: "Diseases of the Throat and Nose," vol. i. London, 1880.

Diagnostic Considerations.

With modern improvements in technique inspection of the larynx is quite possible in the youngest child; but the laryngeal complication seldom occurs in young children until a late stage of the general disease has been reached, when no hope of cure can be entertained, so that it is naturally wiser to avoid disturbing the little patient by an unpleasant examination than to achieve the somewhat empty triumph of diagnosing one of these unusual cases during life. Often, however, the disease is not even suspected, for laryngeal symptoms are remarkably absent from this affection in children. The only common sign is hoarseness, which may progress to complete aphonia; rapid and urgent dyspnœa may also, though rarely, occur, for any laryngeal affection in children is especially liable to be complicated by spasm and œdema. The most terrible and important symptom of tuberculous laryngitis in adults—I mean dysphagia—is hardly ever experienced by children; but I know of no explanation of this remarkable fact.

Prognosis.

The prognosis in children is decidedly worse than in adults, and death usually ensues within a few weeks of the first onset of symptoms. By this time the little patients are generally in the last stages of generalized tuberculosis, and are too ill for any but symptomatic treatment. Urgent dyspnœa calls for tracheotomy, which may then prolong life, but in no way stays the course of the affection. Intubation is absolutely contra-indicated in this as in every ulcerative disease of long duration. Should dysphagia occur, it must be treated by the local application of anodynes, of which orthoform is the most suitable. This is an insoluble powder, and is best applied as an insufflation; it should be introduced by means of a curved insufflator passed beyond the tongue, which must be drawn forward, if necessary, by a Lack's or Escat's tongue-retractor.

Practical Conclusions.

To sum up, tuberculosis of the larynx in children is characterized by its rarity, its tendency to occur only in the latest stage of tuberculosis, and, consequently, by the extreme gravity of the prognosis; and, finally, by the absence of dysphagia, and, as a result, by the ease with which it may escape detection.

The affection is less rare in the late period of childhood, after the age of ten or twelve. It is still uncommon, and partakes to a diminishing degree of the characteristics given above. Thus, it still carries a very grave prognosis, and is found generally only in a late stage of consumption; it usually progresses rapidly, and is but little inclined to cause dysphagia.

IX.

INTRA-THORACIC TUBERCULOSIS IN INFANTS AND CHILDREN.

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TUBERCULOSIS of the intra-thoracic organs in infants and children presents many unsolved problems. The incidence on the various organs, the channels and mode of infection, the means of diagnosis, and even the treatment, are all in greater or less degree the subject of changing opinions or of controversy. It is in regard to the morbid anatomy and histology that the most definite statements can be made, although even here it should not be forgotten that the lesions observed in fatal cases are, as a rule, those of the terminal stages, so that it may be difficult to determine the mode of entry of the bacillus, to establish the site of origin of the tuberculous process, and to trace the course it has taken.

Frequency of Tuberculous Lesions.

From the standpoint of the post-mortem room, tuberculosis is a very common morbid process in early life. The figures given by different authorities vary within wide limits. Thus, Baginsky[1] at Berlin found 18 per cent., Comby[2] at Paris 38·5 per cent., Hamburger and Sluka at Vienna 40 per cent., Müller at Munich 43 per cent., of tuberculous lesions in the cases examined by them. In regard to the incidence on the various organs, Holt,[3] in an analysis of 119 autopsies on tuberculous children, found the lungs implicated in 99 per cent., the pleura in 58 per cent., the bronchial glands in 96 per cent., and the

[1] Baginsky: Quoted in *Berlin. klin. Wochenschrift*, No. 10. 1903.

[2] Comby: "Étiologie de la Tuberculose Infantile," *La Presse Médicale*, p. 765, November 24, 1906.

[3] Holt, Emmett: "Diseases of Infancy and Childhood," fourth edition, p. 1070. New York, 1907.

pericardium in 6 per cent. Hamburger and Sluka[1] found in their 160 cases with tuberculous lesions the lungs affected in 50 per cent., the bronchial glands in 96 per cent. Müller[2] found the lungs involved in 92·67 per cent., the lymphatic glands in 84 per cent., the pleura in 65 per cent., and the pericardium in 2 per cent.

It is difficult to secure clinical records to compare with these, but those available confirm the general opinion that, from the clinical standpoint, tuberculous disease of the lungs is less common than the post-mortem statistics would indicate. Thus, Demme[3] of Berne found only 5·3 per cent. of cases of tuberculosis among 36,148 patients, and of these, only 10·6 per cent. gave evidence of pulmonary tuberculosis.

The statistics of the examination of children in schools give interesting results in this connection. Thus, J. E. Squire and Annie Gowdey[4] found only 0·47 per cent. of cases of pulmonary tuberculosis among 1,670 children, or, if cases with doubtful signs were included, 1·3 per cent.

To explain the discrepancies between the post-mortem and clinical records, it might be suggested that tuberculosis in the young is a very fatal disease; that it is often a terminal affection in the course of other morbid conditions; that it may give rise to signs of so doubtful a character as to be confused with those of other conditions; or, again, that in non-fatal cases the signs may be so slight as to evade detection. Probably all these factors play their part. It is certain that infancy is a condition of extreme susceptibility to tuberculous infection, and one of very limited resisting power. Statistics show that as age progresses more children suffer from tuberculous lesions, although decreasing numbers die from their results, and therefore, presumably, the protective mechanisms become in general progressively more evolved. This is supported by the fact that, whereas in infancy and early childhood the distribution and subsequent course of tuberculous deposits present certain special features, after the age of four or six years the lesions tend more and more to resemble those of adults.

General Features of Tuberculosis in Early Life.

The special characteristics in early life may be briefly summed up as follows: The tubercles show a special proclivity for lymphatic structures, especially the glands, and notably the bronchial glands.

[1] Hamburger and Sluka: "Beitragzur Kentniss der Tuberculose im Kindesalter," *Jahrbuch d. Kinderheilkunde*, 62, p. 517. 1905.

[2] Müller: "Zur Kentniss der Kindertuberculose," *Münch. med. Wochenschrift*, Nos. 50 and 51. 1889.

[3] Demme: "Ueber die Häufigkeit der Tuberculose und ihre hauptsächlichsten Localisation im Kindesalter," *Archiv für Kinderheilkunde*, p. 81. 1884.

[4] Squire, J. E., and Gowdey, A.: London County Council Education Committee Reports, March 31, 1907.

There is also a marked tendency to rapid growth, with conglomeration and subsequent caseation. Reparative processes are strikingly deficient, both fibrosis and calcification being rarities in early life. The secondary changes which occur in the surrounding tissues are of simple irritative or inflammatory character, and are liable to produce conditions tending towards the spread of the morbid changes rather than towards their arrest. It follows from these features that generalization of the tuberculous process is a very frequent result. Hamburger and Sluka found it in 73 per cent. of their cases, Still[1] observed tuberculous meningitis in 48·3 per cent. of those analyzed by him. This general, or vascular, infection may result from breaking-down of a caseous focus into an adjacent bloodvessel, from caseation of "intimal tubercles" in the walls of the bloodvessels themselves, or even from lesions in the thoracic duct.

Channels and Varieties of Infection.

In regard to the channels of infection, it is wise at the present time to maintain a judicial attitude. Leaving out of consideration congenital and inoculation tuberculosis, and infection by way of the tonsil and ear, which together account for a relatively small proportion of the cases, there remain the rival possibilities of infection by inhalation and by ingestion. The protagonists of these respective views uphold their contentions with such a wealth of statistics and of experiment that the issue becomes more involved rather than clearer.

Closely cognate to this problem, though distinct from it, are the questions of the frequency of invasion by the human and bovine types of bacillus, and the relations of these types to one another. These problems are of importance from the practical standpoint in regard to prophylactic measures, and, until more conclusive evidence on all these points is forthcoming, it is safest to assume that infection by either channel is a possibility and a danger to be guarded against. Measures should therefore be taken to avoid contact between children and those known to be tuberculous, and every precaution carried out in regard to milk and other articles of diet likely to be contaminated with virulent tubercle bacilli.

Distribution of Intra-thoracic Tuberculosis.

In regard to the distribution of tuberculous lesions within the thorax, they may be found in the bronchial and mediastinal glands, in the lungs, the pleuræ, and pericardium, in the mediastinum, and in the thoracic duct. Tuberculous masses may also occur in the thorax as a result of deposits in the bony framework—either the spine or ribs.

For descriptive purposes it will be convenient to classify the clinical

[1] Goodhart and Still: "Diseases of Children," p. 375, eighth edition. London, 1905.

manifestations under the following headings: (1) Tuberculosis of the bronchial glands; (2) pulmonary tuberculosis; (3) tuberculosis of the pleura; (4) tuberculosis of the pericardium; (5) multiple serous membrane tuberculosis; (6) tuberculous mediastinitis.

Tuberculosis of the thoracic duct being merely a pathological curiosity, and not recognizable clinically, is not separately considered.

Although each of these conditions may give rise to symptoms and physical signs which dominate the clinical picture, and may in exceptional instances be the only lesions found, it is necessary to emphasize the fact that they may be variously combined, and, further, to point out that it may be impossible to determine the primary lesion and the topography of the morbid process as a whole except at an autopsy. The clinical diagnosis must therefore be taken as indicating the preponderating or dominant site of the lesions, and not necessarily the primary situation.

Tuberculosis of Bronchial Glands.

It has been already stated that the bronchial glands are almost invariably found to be involved at post-mortem examinations on tuberculous children. It is difficult to determine exactly the part played by these glands in the time sequence of the tuberculous process, but it is generally admitted that they are involved early, and that they are extremely susceptible to the activity of the tubercle bacillus. By some observers the presence of the oldest lesions in these glands in any given case has been regarded as direct evidence of aerogenous infection, and as indicating that the bacillus has reached these glands by the lymph channels from the air-passages or air-cells. In the light of recent researches, this view cannot be sustained. Calmette, Guérin and Deléarde[1] have shown experimentally that in young bovine animals, after feeding on a diet containing tuberculous material, the earliest lesions are often in the bronchial glands, although the mesenteric glands may contain bacilli without actual lesions. In other words, the alimentary canal may prove a direct path to the infection of the bronchial glands. It is, therefore, not possible to determine whether these glands are primarily affected in any considerable proportion of cases, or to estimate to what degree their affection is secondary to pulmonary lesions or to alimentary ingestion of infective material. That they are very susceptible to invasion, and that the lesions there induced, if extensive, constitute a grave danger in early life, are, however, facts which are clearly established.

The so-called bronchial glands, or tracheo-bronchial lymph nodes, comprise three chief groups: (1) The *tracheo-bronchial group*, situated at

[1] Calmette, Guérin et Deléarde: "Origine intestinale des adénopathies trachéo-bronchiques tuberculeuses." *La Presse Médicale*, p. 335. 1906.

the bifurcation of the trachea; (2) the *bronchial* group, surrounding the main bronchi; and (3) the *pulmonary* or hilum group, situated at the root of each lung, and extending, with the bronchus, into the pulmonary tissue.

When affected by tuberculosis the glands are enlarged—often very considerably enlarged—and on section they present cheesy-yellow masses of conglomerate caseated tubercles which may be in process of softening. Calcification in these glands is rare in childhood. Not infrequently miliary tubercles may be seen as well as the more advanced lesions. The glands on both sides may be widely involved, forming large masses surrounding the trachea and bronchi, and extending into the lung as smaller outlying masses. If one side only is involved, it is usually the right; and even when both are affected the lesions preponderate on the right side.

The later results of the deposits in these glands may be:

1. Extension into the lung, causing widespread areas of broncho-pneumonic tuberculous deposit, either miliary or caseous in character.

2. Ulceration into a bloodvessel, leading to generalization and acute general miliary tuberculosis.

3. The gland may break down and be discharged into some adjacent viscus—*e.g.*, into the trachea or a main bronchus, sometimes causing death by asphyxiation. It may exfoliate into the œsophagus.

4. The process may extend to the pleura, pericardium, or mediastinum.

Whether small lesions in these glands often become quiescent and are followed by recovery is a question which it is difficult to decide, since they are not likely to give signs or symptoms sufficient to reveal their presence. The frequent presence of old calcified scars in these glands in later life suggests that this is probable.

The *symptoms* produced by tuberculous deposit in these glands are by no means characteristic. An indefinite and progressive condition of ill health in a child previously healthy, leading to anæmia, emaciation, lassitude, and debility without obvious cause, should excite suspicion, especially if there is also a troublesome dry cough, worse at night, and occurring in distressing paroxysms not unlike those of whooping-cough. The appetite often fails, and there may be slight fever of irregular character, while night-sweats may sometimes be a marked feature. Too often the terminal accident of general infection is, however, the first indication of the tuberculous nature of the condition from which the child is suffering.

Physical signs are in general no more characteristic. On inspection the child may appear obviously anæmic and out of health; the face may, it is said, present a somewhat swollen appearance, as in whooping-cough; small dilated veins may be seen over the upper part of the

chest in front, but these are rarely the index of any mediastinal obstruction, and are not infrequently to be observed in conditions where there is no reason to suspect involvement of the bronchial glands; so also the downy growth of hair between the scapulæ is not of any value. On palpation deeply in the episternal notch some glandular thickening may in exceptional cases be noticed. Percussion may reveal slight dullness to one or other side of the manubrium sterni or to one side of the spine—usually the right in the interscapular region—but these signs may be wanting, even though considerable enlargement of these glands exists. Auscultation has been supposed to afford valuable evidence. Grancher[1] attributed great importance to differences in breath-sounds at the two apices, and went so far as to describe three stages characterized by different auscultatory signs. A certain degree of harsher breathing at the right apex is common in children, and it is probable that Grancher exaggerated the importance of this difference as a sign of glandular involvement. In some cases broncho-vesicular breathing, or even bronchial breath-sounds, may be heard at one apex, and this, if associated with dulness in the situations already mentioned, is suggestive, especially if the paroxysmal cough occurs. Bronchophonic voice-sounds and pectoriloquy are also to be observed. D'Espine[2] attaches great importance to these. He states that bronchophony normally ceases at the level of the seventh cervical spine, but that in bronchial gland affections it may be heard as low as the fourth or fifth thoracic spine. I have not found this sign to be of any value, as bronchophony can often be heard in healthy children well down over the thoracic spine. A sign of more value, if it can be established, is the existence of weak breath-sounds over the whole of one lobe, especially the right lower lobe; but it is important to examine the child in various positions and on more than one occasion, since the movements of the diaphragm and of respiration in general are often functionally irregular in children, and weak breathing may be only the expression of a temporary want of synchronism between the two sides of the diaphragm. Eustace Smith[3] has described a sign which is usually associated with his name. A systolic murmur is heard over the upper part of the sternum when the head is thrown as far back as possible. It is, however, not invariably obtained, and it may be present in anæmic children in whom there are no other indications of enlargement of the bronchial glands. Lastly, radiographic examination of the chest may be employed, using either the screen or taking photo-

[1] Grancher: "La Tuberculose ganglio-pulmonaire dans l'école parisienne," *Bulletin de l'Académie de Médecine*, vol. lvi., p. 379, 1906; also vol. li., p. 334, 1904.

[2] D'Espine: "The Early Diagnosis of Tuberculous Bronchial Glands in Children," *La Clin. Infant*, March, p. 173. 1907. Abst. in *British Journal of Children's Diseases*, p. 306. 1907.

[3] Smith, E.: "On the Diagnosis of Enlarged Bronchial Glands in Children," *Lancet*, p. 240, August 14, 1875.

graphs. If the glands are considerably enlarged, they may in some cases be readily visible, but in many cases nothing is to be made out.

From the account just given it can readily be inferred that the diagnosis is often a matter of great difficulty. The most that may be possible in many cases is to suspect strongly the existence of the glandular affection. Asthma, whooping-cough, and the cough of chronic tonsillar hypertrophy and adenoids, may all have to be considered in arriving at a diagnosis.

Tuberculosis of the Lungs.

The types of pulmonary tuberculosis differ somewhat at different ages, and under the age of four years there is a tendency for all the lesions to be miliary or caseous and of somewhat irregular or disseminated distribution. After the age of four the tendency to reparative processes brings the cases more and more to resemble those of adults.

From the pathological standpoint we may classify the cases into groups, corresponding in the main to those of adults—viz.: (1) Acute miliary tuberculosis; (2) acute caseous tuberculosis; (3) chronic or fibro-caseous tuberculosis.

A fibroid form is not met with until later childhood and adult life.

The differences in distribution, however, render the clinical manifestations different from those of the corresponding forms in later life, but a classification on a pathological basis is to be preferred to a purely clinical one.

Miliary Tuberculosis of the Lungs.

This condition is in the majority of cases part of a general miliary tuberculosis, but occasionally the miliary outbreak may be almost, or even entirely, confined to the lungs. At the autopsy the pulmonary tissue is found to be thickly studded with small grey miliary tubercles. They may be seen clearly under the pleura, and on section they project as small, glistening, translucent bodies, slightly larger than a pin's head. The tissue around them may be practically natural in appearance if the deposit has occurred only shortly before death, or there may be areas of consolidation of racemose distribution if time has elapsed sufficient for reactive changes to occur. If the tubercles are very numerous, there may be almost complete consolidation of extensive areas to such an extent that it is difficult to conceive how the blood can have been aerated. Careful search will usually reveal a caseous focus in a condition of softening to which the miliary outbreak can be referred. It is frequently in the bronchial glands, but may be found in an old intra-pulmonary focus. Sometimes the cause of the general infection may be referable to breaking down in an intimal tubercle in the bloodvessels.

It is difficult to give a satisfactory clinical picture of this condition. It occurs chiefly in infants, and it represents the minimum of resistance. Its course is, as a rule, rapid, being a matter of a few days. The symptoms and signs depend largely upon the distribution of the tubercles in other organs when there is generalization, and they are often strikingly few as regards the lungs.

Various types may be differentiated clinically, but they tend to merge one into the other. Of these types four may be briefly outlined:

1. The *marasmic*, in which the symptoms may be those of progressive emaciation with gastro-intestinal disturbances, and sometimes with swelling of the abdomen. Pulmonary symptoms may in such cases be entirely absent.

2. The *acute febrile type*, with marked fever, continuous or remittent in type, associated with rapidly increasing dyspnœa, cyanosis, and exhaustion, but often with relatively few pulmonary signs, a combination which is highly suggestive. The pulse is rapid and small, the spleen is frequently enlarged, and gastro-intestinal symptoms may be present. Death may occur from exhaustion, or may follow on the onset of meningeal symptoms.

3. The *meningeal type* is perhaps the most characteristic. The symptoms are those of meningeal irritation, followed by compression, the pulmonary symptoms being slight, or even entirely wanting.

4. The *pulmonary type* may begin acutely, like a simple broncho-pneumonia, with fever, malaise, cough, and even convulsion; or more insidiously with anorexia, languor, and debility. Respiratory symptoms, especially dyspnœa, rapidly supervene, the dyspnœa being of expiratory character. Cyanosis is an early and a marked feature, and may be out of all proportion to the extent of the physical signs. The pulse is rapid, and the general appearance is that of serious illness. Cough is frequent, distressing, and usually not accompanied by expectoration. The physical signs are those of a disseminated broncho-pneumonia, and present no characteristic features.

The diagnosis of these cases may only be established when meningeal involvement supervenes or some other obviously tuberculous manifestations are present, such as tubercles in the choroid or tuberculous furuncles in the skin. In other cases the family history, the association with other tuberculous subjects, the appearance of the child, the disproportion between the signs and the symptoms, may give rise to strong suspicion of the specific nature of the broncho-pneumonic process. The diagnosis of the marasmic form from congenital syphilis and from gastro-intestinal conditions, and that of the acute febrile form from enteric fever, may also have to be considered.

Caseous Tuberculosis of the Lungs.

This form represents the common type of pulmonary tuberculosis in young children, and is the expression of infection where there is a slightly greater resisting power than when the miliary form occurs. Pathologically, two forms may be recognized—a lobular or broncho-pneumonic form, which is the more common, and a lobar or pseudo-lobar form. In both, the essential lesions are aggregations of caseous tubercles surrounded by areas of consolidation, which are in turn involved in the caseous process. In the lobular form the distribution follows the ramifications of the bronchi, and the caseous patches therefore present a racemose appearance; whereas in the lobar form, the whole of a lobe, or the whole of one lung, may be involved to form a solid mass of yellowish, mottled appearance, to which the name of "cheesy consolidation" has been applied by Goodhart. In both forms softening may occur, and small cavities may result; but they are situated deeply and near the root of the lung, and may therefore fail to give rise to physical signs. The bronchial glands are usually extensively involved, and they may appear to be the origin of the pulmonary invasion. Cavities have been stated to be infrequent in children, but on post-mortem examination they prove to be relatively common, and may occur even in very young infants. They are small, often deeply situated, irregular in outline, and they may contain lung tissue in process of disintegration. Pneumo-thorax may occur, but is rare, and is also difficult to recognize clinically. Cruchet,[1] of Bordeaux, states that it is more often seen under the age of four years than between the ages of four and fifteen years. It usually occurs at the base of the left lung, and the resulting effusion is always purulent. Pleurisy is common, but it leads to adhesion as a rule, and only very exceptionally to effusion, which, when it occurs, is often purulent. Laryngeal and intestinal ulcers may occur in this form as in adults.

The onset may be more or less acute, but is frequently insidious, and the condition may occur as a sequel of some infective disease, notably of measles and whooping-cough. The child soon appears ill; anorexia, fever, night-sweats, and cough develop, and some degree of wasting or emaciation early becomes noticeable. The cough is loose, and may be followed by vomiting or by expectoration, but the sputum is more often swallowed. Hæmoptysis may occur in the form of streaking; but profuse hæmoptysis, though it does occur, is rare. There is some dyspnœa, but cyanosis is not a marked feature until quite late in the disease.

The physical signs are generally more characteristic than in the form previously described. The children often present the delicate

[1] Cruchet: "Le Pneumothorax chez l'enfant," Reports of International Congress on Tuberculosis at Paris, vol. ii., p. 293. 1905.

appearance, with clean-cut features, fine complexion, good eyes, and long sweeping lashes, which have for so long been regarded as characterizing the tuberculous type or they may conform to the strumous antitype, with coarse features and complexion and rougher mould of build. In either case the face may present a suggestive appearance, with flushed cheeks and bright eyes, in contrast to the pale mucous membranes. The hair is usually lank, dry, and lustreless; the skin of the trunk rough; and a characteristic smell may also be noticed with advanced cases. The chest is long and narrow, thinly covered, and may show some local flattening or limitation of movement. Signs of consolidation of somewhat irregular distribution may be observed in the broncho-pneumonic form, while dulness, tubular breath-sounds, increased voice-sounds, and pectoriloquy, confined to one lobe or to one lung, may be found in the cases of cheesy consolidation. Adventitious sounds are often scanty, or may be absent, but crepitations and crepitant râles are not uncommon. Actual signs of cavitation are difficult to establish, since the high-pitched cavernous breathing may be mistaken for the tubular breathing of consolidation.

The diagnosis of these cases is often not a matter of difficulty; the appearance, the history, and the physical signs may all be suggestive, and tubercle bacilli may be demonstrated in the sputum, if that is obtainable.

Fibro-caseous or Chronic Pulmonary Tuberculosis.

In its general features this variety conforms to the characters observed in adults. It is almost unknown under the age of four years, and is rare before six years, but after that age it becomes more common. It represents the development of greater powers of resistance evidenced by the tendency to the formation of fibrous tissue, and to the limitation of the extension of the process. There are certain differences from the typical distribution of the lesions in adults, in that they are less often apical, and are frequently more extensive near the root of the lung, so that when cavities form they are usually in the lower part of the upper lobe or in the inter-scapular region. The cases are often chronic in course, and of fairly good prognosis under favourable conditions. In some of those which tend towards recovery, there may be bronchiectasis in the lower lobe of the affected side.

Clinically, these cases differ but little from the corresponding cases in adults. The onset may be insidious, or may follow a succession of catarrhal attacks, or in some instances it may be the sequel of a pleurisy. A chronic cough, with vomiting or expectoration, and associated with progressive wasting or ill-health, should lead to a very careful examination of the chest. The physical signs are in general sufficiently characteristic, and follow on similar lines to those of adults. In

auscultation it is necessary to examine with special care the axillary and the inter-scapular regions. The diagnosis of these cases requires careful consideration of the history, symptoms, and physical signs, in order to eliminate other causes of chronic cough, such as chronic bronchitis, bronchiectasis, and chronic tonsillar hypertrophy.

Tuberculosis of the Pleura.

Although some degree of pleurisy is common as a secondary process in tuberculosis of any of the intra-thoracic organs, and especially so if the lungs are involved, a primary tuberculous pleurisy or a pleurisy which is the most marked feature of the clinical picture is rare—at any rate, until later childhood. The pleurisy associated with pulmonary tuberculosis is usually a dry pleurisy due to a deposit of tubercles under the pleura, and leads to adhesion of the lobes to one another and to the parietal pleura. It is rare for it to give rise to physical signs distinguishable from those of the primary lesion.

Sometimes, however, an effusion occurs into the pleura, and it may be serous, sero-purulent, purulent, or hæmorrhagic in character. Two noteworthy differences from the exudative pleurisies of adults may be mentioned—viz., the greater frequency of purulent effusions and the relatively small number of tuberculous effusions. In regard to empyemata, the statistics of Netter and Koplik show that tubercle bacilli are found in only 5 to 7 per cent. of the cases, whereas pneumococci are found in 60 to 80 per cent. Even the serous effusions seem to be rarely of tuberculous origin, in striking contrast to the conditions in adults. Nathan,[1] after a careful examination of the after-history of a number of cases of serous effusion in children, failed to establish the definite relation to tuberculosis that undoubtedly exists in adults.

The symptoms and physical signs, as a rule, present nothing characteristic. A child suffering from fever, dyspnœa, pain, and obvious distress is found to give physical signs suggesting the presence of fluid in one pleura. In this connection it is important to remember that tubular or bronchial breath-sounds may be heard over the dull area and that the voice-sounds may be increased. Important signs are a skodaic note under the clavicle and displacement of the heart or other viscera. The tuberculous nature of the process may be suspected if a cytological examination of the fluid reveals a marked preponderance of lymphocyte , if it is hæmorrhagic, or if cultural examination proves negative. The actual proof may only be forthcoming after animal inoculation or at the autopsy.

[1] Nathan: "Ueber den Zusammenhang zwischen seröser Pleuritis und Tuberculose im Kindesalter," *Archiv f. Kinderheilkunde*, vol. xxxviii., p. 183. 1904.

Tuberculosis of the Pericardium.

An outbreak of grey miliary tubercles may occur as part of a generalized miliary tuberculosis. The tubercles are scattered in both the visceral and parietal layers of the membrane. They usually appear so shortly before death as only to give rise to localized inflammatory reaction and not to influence the clinical features of the case. An invasion of the pericardium by extension from tuberculosis of adjacent structures occasionally results—*e.g.*, from the mediastinal or bronchial gland, the pleura and peritoneum, and from pulmonary tuberculosis. The growth of tubercles may lead to a fibrinous exudation and to caseation, and even to serous effusion. The condition, however, is one of considerable rarity, and is liable to be overlooked clinically, or if effusion occurs to be regarded as non-tuberculous.

Multiple Serous Membrane Tuberculosis.

In some cases it seems as if there were a special liability for the serous membranes to be affected, either simultaneously or successively —such as one pleura and the peritoneum, one pleura and then the other, pericarditis and left-sided pleurisy, and one pleura—then the peritoneum and then the other pleura. These cases have not attracted much attention in this country. Kingston Fowler[1] and Frederick Taylor[2] have both recorded cases, the latter pointing out the importance attached to these cases by Italian observers. A special term has been applied to them—viz., polyorromenitis—a not very euphonious substitute for the clumsy hybrid polyserositis. The cases occur in older children, and the prognosis is not unfavourable. Similar combinations occur in pyæmia and in rheumatism.

Tuberculous Mediastinitis.

Tuberculous processes in the mediastinum are not very uncommon. They vary from a deposit of tubercles in the mediastinal tissues to extensive abscesses. The process may extend from the pleura or pericardium constituting a mediastino-pericarditis and leading eventually to more or less matting of the mediastinal structures, or it may go on to the formation of extensive abscesses, the result of caseation and softening in connection with the bronchial or mediastinal glands, or from tuberculosis of the thoracic part of the spinal column or of the ribs and sternum. The abscesses so formed may rupture into the pleura, the pericardium, the great veins, or on to the surface.

The symptoms may be slight or absent if there is only dry mediastinitis, and the only physical sign may be a pleuro-pericardial friction

[1] Fowler, K., and Godlee: "Diseases of the Lungs," p. 587. London. 1898.
[2] Taylor, F: "On Polyorromenitis or Combined Serous Inflammations," *British Medical Journal*, December 15, p. 1693. 1900.

rub. If an abscess form, the symptoms may be pain, with febrile temperature, rapid pulse, dyspnœa, and dysphagia; and the physical signs those of mediastinal pressure evidenced by venous obstruction, displacement of organs, together with dulness over the sternum. Sometimes the abscess may point anteriorly.

Diagnosis of Tuberculous Disease in Childhood.

By physical examination it is in many cases not possible to do more than make a provisional diagnosis. To establish the tuberculous nature of any case it is necessary to have recourse to some of the special methods. Sputum examination is difficult in many cases, owing to the difficulty of obtaining sputum, although Holt has recently shown that this difficulty may be overcome in a considerable number of cases by securing on gauze any material coughed up when the pharynx is irritated so as to excite cough. The mucus in the vomit and in the fæces has been employed for testing for bacilli, but is unsatisfactory. The tuberculin reaction applied with care is a valuable means of diagnosis if the case is afebrile. A dose of Koch's original tuberculin (0·0001 to 0·0005 gramme) may be injected, and its effect upon the body temperature noted. If negative, it may be repeated with a slightly larger dose, but not more than 0·001 gramme.

Von Pirquet's[1] cutaneous reaction seems to give good results in very young children, but cannot be relied upon after the age of two years. It is carried out by inoculating 25 per cent. tuberculin into some scratches on the skin, a small papule appearing within twenty-four hours if a positive result is obtained.

The ophthalmo-reaction suggested by Wolff-Eisler, and applied clinically by Calmette, promises to afford a valuable means of diagnosis in obscure cases, although its limitations are not yet fully established. It fails in advanced cases, and should not be employed too soon after a diagnostic injection of tuberculin, or be repeated, if negative, until an interval of several days after the first application. It was originally carried out by means of a 1 per cent. solution in sterilized water of a precipitate obtained by alcohol from tuberculin. Comby recommended a solution half that strength, and now even weaker ones are employed. The determination of the opsonic index of the child's serum for the tubercle bacillus may also be employed, an index much below or much above the normal limits being suggestive.

Prognosis of Tuberculosis in Infancy and Childhood.

The prognosis of any tuberculous affection in the first year of life appears to be practically hopeless, and during the second year only

[1] Von Pirquet: "Tuberculin-diagnose durch cutane Impfung," *Berlin klin. Wochenschrift*, No. 20, p. 644. 1907.

a very small proportion of the cases show any tendency towards arrest; but after this period increasing numbers run a chronic course or tend towards arrest, and may thus be regarded as favourable. The question of prognosis in relation to age is discussed in a very suggestive manner by Engel, who, from an analysis of post-mortem statistics, states that in the first six months all the cases end fatally, from that time until the tenth year about two-thirds are fatal, and from eleven to fourteen years about half, showing a total mortality in childhood about twice that of adult life. He maintains that tuberculosis is curable in children so long as it remains confined to the lymphatic glands, and he points to the favourable prognosis of tuberculous lymphadenitis in the neck. He lays stress on the importance of early diagnosis of the bronchial gland cases before the process has transgressed the capsule of the gland. He is hopeful that with early diagnosis of such cases, confirmed by tuberculin reactions, treatment with tuberculin may give better results than those at present obtained.

Principles of Treatment.

(*a*) *Prophylactic.*—Every care should be taken to protect infants and young children from infection. The most rigid cleanliness in the nursery and in regard to feeding should be enforced. If milk forms part of the diet its origin should be known, and, unless it comes from cows known to be free from tuberculosis, it should be sterilized or boiled. The child should be kept from contact with persons suffering from active tuberculosis.

(*b*) *Climatic.*—Children, especially those living in towns, derive great benefit from change of air and scene; and it is especially in the vague cases of ill-health and the early cases—the so-called "pre-tuberculous" conditions of French writers—that such change is particularly to be advised. The seaside is by no means essential, although the benefits derived in many cases, especially joint and bone cases, at Margate and the neighbouring resorts is well known. Too cold or windy a place is not to be recommended; on the whole, it is perhaps best to send pulmonary cases to inland resorts.

(*c*) *General Regimen.*—It is of special importance that the practitioner in charge of a case of early tuberculous disease in a child should give specific instructions to the parents in regard to the general management, since children cannot, as a rule, be sent to sanatoriums. The importance of rest, of avoiding fatigue, and of the arrangement of the child's living and sleeping room, must be explained to the parents, and also the necessity for prolonged care and treatment.

(*d*) *Diet.*—The diet of a child with tuberculous disease should be abundant, and should contain a liberal allowance of fatty foods in the form of milk, cream, and butter. Raw meat is recommended by not a

few authorities, and can be well digested by many children. The digestive powers of the child should not be taxed by excessive feeding or by unsuitable food.

(*e*) *Drugs* are not, as a rule, necessary. The syrup of the iodide of iron or other hæmatinic may be given if there is marked anæmia, or arsenic may be given in small doses. Occasionally some slight symptomatic treatment may be necessary. Cod-liver-oil and malt preparations are, as a rule, well taken, and may be given.

(*f*) *Specific Treatment.*—Recently there has been a revival of the use of tuberculin in the treatment of tuberculous affections, and although comparatively few observations are on record in regard to children, they are encouraging rather than otherwise. Small doses should be given in carefully selected cases, such as cases of early or localized lesions with little or no febrile reaction, and the results carefully watched. Clive Rivière[1] has recorded cases treated by minute doses ($\frac{1}{12000}$ to $\frac{1}{3000}$ milligramme, according to age), controlling his results by opsonic determinations. Ganghofner,[2] of Prague, employed larger doses, commencing with $\frac{1}{100}$ milligramme.

In cases of acute miliary or rapidly advancing caseous tuberculosis the treatment can at present only be palliative; but it is to be hoped that before long bacteriological methods, which have afforded us means of earlier diagnosis, will yield specific forms of treatment, and enable the disease to be arrested while it is still localized.

[1] Rivière, C.: "The Vaccine Treatment of Tuberculosis in Children." *British Medical Journal*, April 13, p. 859. 1907.

[2] Ganghofner: "Ueber die therapeutische Verwendung des Tuberculins im Kindesalter," *Jahrbuch der Kinderheilkunde*, vol. lxiii., p. 525. 1906.

X.

PULMONARY TUBERCULOSIS IN INFANCY AND EARLY CHILDHOOD.

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Until quite recently tuberculosis of the lungs, as compared with other forms of tuberculosis occurring in infancy and early childhood, was considered an infrequent clinical condition, although post-mortem observations had shown that the lungs were more frequently the seat of tuberculosis than any other organ; they were involved in 99 per cent. of my own autopsies upon tuberculous patients. With more accurate means of diagnosis the lungs must be regarded in infancy, as in later life, the most frequent clinical seat of tuberculous disease. Children with pulmonary tuberculosis for the past few years have formed 4·5 per cent. of admissions to the Babies' Hospital of New York, where nearly all our patients are under three years old. The proportion has been found to have steadily risen as our diagnostic methods have become more exact. The percentage of pulmonary tuberculosis indicated in hospital practice would, however, appear not to hold generally. It would be very much smaller in the country and among children living in good surroundings; but among those whose residence is in large cities and in crowded tenements I do not think that the figures given are far above the general average. Besides the cases classed strictly as pulmonary tuberculosis, our observations have shown the presence of bacilli in the sputum in 52 per cent. of the cases of tuberculous meningitis under observation in the hospital, although in many cases there were either no pulmonary symptoms, or such symptoms and signs as were present were so slight as to be readily overlooked.

Mode of Pulmonary Infection in Early Life.

My own observations lead me to the conclusion that pulmonary tuberculosis in infants and young children is much more frequently acquired through contact with tuberculous patients than in any other

way. The chances of infection in infants are increased, since the young child is indoors the greater part of the time, and is in contact with, or in the care of, the invalid more often than would be the case with older children. Besides, he is playing about the floor and constantly putting things into his mouth. For the past two years the family history has been carefully investigated in all the cases of tuberculosis admitted to the New York Babies' Hospital. A definite evidence of tuberculosis in the household was found in thirty-three of seventy-three cases of pulmonary tuberculosis, or 45 per cent.; and, besides, a similar history in eleven of twenty-eight cases of tuberculous meningitis in which bacilli were found in the sputum, although nearly one-third of these had no pulmonary symptoms or signs.

Infection through the intestinal tract by means of tuberculous milk I believe to be a very infrequent means of acquiring tuberculosis in infancy. While it is undoubtedly possible that bacilli entering the digestive tract might find their way to the lung and bronchial glands without producing intestinal lesions which can be demonstrated at the autopsy, such does not seem to be the usual course nor such the most natural interpretation of the conditions found at post-mortem examination. As I have observed them, the intestinal lesions, even in cases of advanced pulmonary tuberculosis, are usually of a minor character. In not more than 1 or 2 per cent. of the cases is the oldest lesion found in the intestine or mesenteric glands.

Infection may take place by inhalation, by way of the respiratory tract through the trachea and bronchi, or by the adenoid tissue of the pharynx, or by the mouth through the tonsils or elsewhere from contact with hands, toys, or other articles which carry tubercle bacilli, or by the kiss of a tuberculous person. Until we have positive proof that the bacilli found in the pulmonary tuberculosis of infants are usually of the bovine type, I believe that we must assume that by far the greatest danger of an infant's becoming infected with pulmonary tuberculosis arises from association with persons suffering from the disease.

Clinical Varieties of Pulmonary Tuberculosis in Early Life.

The clinical forms of infantile tuberculosis may be connected with the four principal pathological conditions:

(1) Bronchitis with small scattered tuberculous nodules;
(2) Tuberculous broncho-pneumonia with areas of consolidation, small or extensive, which may be followed either by caseation and excavation, or by chronic fibrous pneumonia;
(3) General miliary tuberculosis of the lungs;
(4) Tuberculosis of the bronchial glands.

Bronchitis with Small Tuberculous Nodules.

The symptoms of this condition are few and indecisive, and may differ in no wise from bronchitis due to other causes. Tuberculosis may not even be suspected until the lesion has been so far developed as to put the case in the second group. Cough is present, but has nothing about it that is characteristic except its persistence. Fever may be absent for a long time, but comes with advance in the lesion, and is then low and irregular, the temperature generally varying from 99° to 101° or 102° F. There may be slow but progressive loss in weight, or the infant may gain regularly for a number of weeks in spite of the cough. The nutrition is influenced much more by the condition of the digestive organs than by the tuberculous process. Other symptoms, generally regarded as belonging to early tuberculosis, such as pallor, anæmia, perspiration, etc., are usually absent. The physical signs are few and not distinctive; scattered râles, sometimes coarse and sometimes finer but inconstant, are all the signs that are present for a long time, often several weeks.

Cases like these are recognized as tuberculous only by finding bacilli in the sputum or by one of the tuberculin tests. It has been my custom to consider as probably tuberculous every infant who has been for any length of time in contact with a tuberculous parent or other tuberculous member of a household. Regarding all such infants as suspicious has led us in hospital practice to search the sputum carefully for bacilli, with the result of finding them, sometimes in great numbers, in infants whose only outward symptom was a moderate cough, and who were admitted to the hospital for some other reason.

At other times tuberculous infants have been discovered by making routine tests of the hospital inmates with tuberculin to obtain Calmette's ophthalmic reaction. Again and again has it happened that a typical reaction has been obtained in a child not hitherto suspected, the diagnosis being confirmed by finding subsequently bacilli in the sputum, though signs in the chest were few and indefinite and general symptoms entirely wanting. How many infants there are with such a form of tuberculosis one can only conjecture, but their number is, I am convinced, not small. They form a very distinct but a very important group of tuberculous cases. For the regularity with which bacilli are present in the sputum indicates what a factor they may be in spreading the disease. How many recover, and in how many the disease goes on to development of more serious lesions, it is impossible to say.

Tuberculous Broncho-Pneumonia.

A tuberculous broncho-pneumonia is altogether the most frequent form of pulmonary tuberculosis seen in young children. Its onset in most cases is gradual, its progress being marked by weeks. In this it

is sharply distinguished from common acute broncho-pneumonia, whose advance is marked by days. It may be preceded by the symptoms described above, or it may follow an attack of measles, whooping-cough, or influenza. The early symptoms are cough, fever, anæmia, and a weight which is at first stationary, but soon shows steady loss. There is no expectoration, and sweating is rare. The cough is generally dry, persistent, teasing, and occurs especially at night. The temperature is usually from 99·5° to 102° F., the general range being higher and the daily variation wider as the disease advances. The anæmia is only moderate; the prostration and impairment of nutrition may not be marked for quite a long period.

The physical signs are generally those of a partial or complete consolidation, or perhaps only of a localized bronchitis, usually with some dry pleurisy. These signs may be present anywhere in the chest, but the most significant location is the anterior part of the chest, but not at the apex. Especially suspicious are signs about the middle of the lung near the nipple, and more often on the right side than on the left side. This appears due to the fact that the process in young patients so often involves the lung by extension from the bronchial glands at the root of the lung. The earliest signs are râles, which may be of all sizes, friction sounds, broncho-vesicular respiration, and slightly impaired resonance or even dulness. The voice is slightly increased. Later there are signs of complete consolidation—marked dulness, increased fremitus, bronchial respiration and voice; but still râles and friction sounds are generally heard.

The later symptoms of tuberculous broncho-pneumonia depend upon what course the pathological process follows—whether (1) partial resolution and a subsequent development of a chronic fibrous inflammation, (2) diffuse caseation, or (3) localized caseation and excavation. The first termination in partial resolution and subsequent fibrosis is indicated by a very gradual fall in the temperature, which may be many weeks before reaching normal, and by a slow improvement in the cough, weight, anæmia, etc. The physical signs are those of an unresolved or slowly resolving pneumonia, in which the area of consolidation gradually diminishes, but the signs do not altogether disappear. When recovery goes farther, there is left only slight dulness on percussion, broncho-vesicular respiration, a few râles, and friction sounds. Such signs may last indefinitely, exacerbations and remissions occurring from time to time. Usually the signs are present over a portion of a lobe, especially anteriorly; sometimes an entire lobe, and in rare instances almost an entire lung, may be involved. Neither by temperature, general symptoms, or physical signs, can cases of this kind be distinguished from simple chronic broncho-pneumonia.

If the process terminate in diffuse caseation, or in localized caseation

and excavation, the symptoms are usually continuous and progressive until the death of the patient. If caseation exists without excavation there is a continuous fever, the range of which is generally from 100° to 103° or 104° F.; marked cough, but very little expectoration; slow wasting, but frequently no more than is seen in any continuous febrile disease, with the usual digestive symptoms which might accompany any fever. The physical signs differ little from those of a lobar pneumonia with extensive and complete consolidation, except that the dulness on percussion is usually greater. There may be even flatness so marked as to suggest the presence of a pleural effusion. Empyema is often the diagnosis made. The symptoms and signs mentioned may persist until the death of the patient from exhaustion.

If the caseation is localized and followed by excavation, the symptoms differ somewhat from those just described: The wasting is more rapid; the temperature assumes more of a hectic type; sweating is frequently present; the anæmia and exhaustion progress more rapidly. Expectoration may be abundant, and either expelled with the cough or vomited. Digestive symptoms are generally marked; the spleen and liver are frequently enlarged, and also most of the superficial lymph nodes.

The cavities are often so small and deeply seated so as not to be recognized by physical signs. If large and superficial, they give the same signs as in adults. Like the areas of tuberculous pneumonia, they are most frequent in the middle zone of the lung in front, in axillary region, or posteriorly. They give cracked-pot resonance, amphoric voice and respiration, and the cavernous whisper. It should, however, be remembered that in the young child very similar signs are often present where there are only dilated bronchi associated with a fibroid condition; they may also be present when a superficial bronchus is surrounded by an area of diffuse caseation. Cavities are very often diagnosticated where they do not exist, and quite as often overlooked when present.

Acute Miliary Tuberculosis of the Lungs.

While scattered groups of miliary tubercles are generally found in the lungs or pleura in the vicinity of tuberculous nodules or areas of tuberculous pneumonia, there are cases in which there are no large areas of consolidation and no tuberculous nodules even, but the lungs are studded with small miliary tubercles so closely set as practically to fill the whole of both lungs. This is not a common form of pulmonary tuberculosis, but may be met with even in young infants. Both the general and pulmonary symptoms and the physical signs are rather obscure and indefinite, and often the diagnosis is not made. As I have seen it in infants and young children, it has not generally been attended

by a high temperature, 101° to 103° F. being the usual range. In the early part of the disease it is often somewhat lower than this, and toward the close perhaps rather higher. It is not a hectic type of fever, and it seldom touches the normal line.

The duration of the disease in these cases, after fairly definite symptoms begin, varies from ten days to a month. At first, and often for two or three weeks, the temperature is almost the only symptom. Cough is slight, inconstant, and seldom loose. The respirations are only moderately accelerated, in many cases not enough to draw attention to the lungs as the seat of disease. There is no rapid wasting, the loss in weight being usually not more than would be expected with any other febrile disease. None of the other symptoms suggest tuberculosis. The usual problem in diagnosis is to discover the cause of the fever. Often the most careful examinations of the chest made daily reveal nothing more than a few scattered râles; these change in position from day to day, and it frequently happens that for days none are heard. After the disease has progressed somewhat farther, the liver and spleen are generally enlarged, cerebral symptoms may develop, and the case terminate as tuberculous meningitis; but more often it is the pulmonary symptoms which are dominant. The respiration becomes more rapid, but usually less so than in ordinary broncho-pneumonia; the cough is frequent, but rarely loose; there may be attacks of cyanosis. Still, the only definite signs are the râles, now fine and moist, and generally diffused over the chest. The case usually ends in death by exhaustion, but without rapid or marked wasting. One of the most striking things in the clinical picture is the disproportion between the severity of the general symptoms and the few pulmonary signs.

Tuberculosis of the Bronchial Glands.

The degree to which the lymph nodes at the root of the lung are involved is one of the most characteristic features of the tuberculosis of early life. It is not only the glands situated along the trachea and at its bifurcation, but those which follow the larger bronchi some considerable distance in the lung. In some types of the disease the glandular lesion is the most important one, and dominates the clinical picture. Enlarged tuberculous glands may exist as the sole tuberculous lesion, but they are more often associated with an area of old tuberculous pneumonia which has gone on to a fibroid condition, with a few old scattered tuberculous nodules, or with a chronic tuberculous pleurisy. Symptoms may be entirely absent, even though the glands may have attained considerable size. In other cases there is present a paroxysmal cough, which in many respects resembles pertussis, but in infants the paroxysms are apt to be more prolonged and less severe than those of pertussis. Sometimes there is only a teasing, irritating cough, which

lasts the greater part of the night. The cough is apparently due to irritation of the recurrent laryngeal nerve, which is often pressed upon by the large glands.

The physical signs are few but quite characteristic if the glands are large and situated posteriorly. In my own experience they are more often upon the right than the left side. The most important signs are bronchial voice, or, better, bronchial whisper, and bronchial breathing over a small area close to the spine, extending from about the fifth to the eighth dorsal vertebra. There may be slight dulness made out on percussion, especially if the patient has thin chest walls. Occasionally very positive information is given by the X ray, the radiographic shadows showing quite definitely the glandular masses, always better on the right side than on the left on account of the heart.

In rare cases it happens that a caseous bronchial gland ulcerates into the trachea, or more often one of the larger bronchi, generally one of the primary divisions. This produces symptoms like those from the entrance of a foreign body into the air-passages, which in point of fact it really is. There is a sudden paroxysm of violent cough and dyspnœa ending in severe asphyxia, which may even be fatal. It may be accompanied by pulmonary hæmorrhage of alarming extent. If the opening is into a small bronchus the symptoms are less distinctive, but may be followed by a rapid general involvement of the lung in an acute tuberculous process, the explanation of which is discovered only at the autopsy.

Diagnosis of Pulmonary Tuberculosis in Young Subjects.

A diagnosis of tuberculosis by rational symptoms alone is almost impossible. We recognize it often by knowing when to look for it. Thus an accurate knowledge of the family history and previous surroundings of the patient are of the greatest value. In a young child, one of whose parents has the disease, or in one who has been closely exposed to infection, tuberculosis should be suspected as soon as a chronic cough develops, or fever not readily explained by other conditions. The gradual onset of the symptoms in most cases distinguishes tuberculous processes of the lung from other pulmonary affections. By physical signs we may be able to determine that the lungs are the seat of the disease, but not that the lesion is a tuberculous one. This must be decided by other means of diagnosis. Neither a bronchitis nor a consolidation due to tuberculosis gives different signs from these conditions when due to the pneumococcus or streptococcus. Especially significant of tuberculosis are areas of consolidation anteriorly, involving the middle zone of the lung; also to be regarded with suspicion are consolidations in delicate children in which resolution does not readily take place. The longer the process persists, the

greater is the probability of tuberculosis. In differentiating between tuberculosis and other forms of chronic consolidation, one should not lay too much stress upon temperature, prostration, wasting, or sweating, because in many cases they give no information. Definite signs of cavity formation are almost conclusive evidence of tuberculosis, but such signs are often wanting even when cavities of considerable size are present. The temperature curve is rarely of much value in differentiating between simple and tuberculous pneumonia, one reason being that in the great majority of pulmonary tuberculosis cases a mixed infection with the pneumococcus is present. In some pulmonary cases, where doubt exists, an examination of blood may give a useful hint. A low leucocyte count—under 10,000—strongly favours tuberculosis, but a higher one—above 20,000—by no means excludes tuberculosis. The percentage of polymorphonuclear cells is, as a rule, higher in pneumonia than in tuberculous processes, but there are many exceptions.

A positive diagnosis of tuberculosis is made only by the discovery of the bacilli in the sputum or by one of the tuberculin reactions.

Examination of the Sputum of Infants and Young Children for Tubercle Bacilli.

In nineteen months sixty-seven cases of pulmonary tuberculosis were observed in the Babies' Hospital; sixty-two of the patients were infants under two years, and fifteen were under six months of age. Bacilli were found in the sputum in over 80 per cent. of the cases, although in over half of them the disease was not advanced, judging by symptoms and physical signs. Discovery of the bacilli in the sputum of young infants is, therefore, by no means impossible, nor even a very difficult matter. Both time and patience are required, for in most cases repeated examinations are necessary. Infants do not expectorate, but cough up the bronchial secretion into the pharynx and swallow it. Sputum must, therefore, be obtained from the pharynx or the œsophagus; to seek for the bacilli in the vomitus, as has been recommended, is almost a hopeless task. The method which has given me the most satisfactory results is to excite a cough by irritating the pharynx, and then to catch the sputum brought into view upon a bit of gauze or muslin. The cough may be excited by a spoon or a tongue depressor; or, better, by a small bit of muslin in the jaws of an artery clamp. Upon this the secretion is easily secured when it is brought up by the cough. Muslin is better than gauze or absorbent cotton. Inversion during the paroxysm of coughing sometimes causes the infant to discharge a considerable mass of mucus into a sputum cup. By the procedure mentioned it has not been found more difficult to obtain good sputum for examination than in corresponding stages of the

disease in adults. "Good" sputum may be described as muco-purulent masses; in the clear, glairy mucus, bacilli are very seldom to be found.

The Use of Tuberculin in Diagnosis in Young Subjects.

I have used tuberculin injections 102 times in infants for diagnosis, either in those suspected of having tuberculosis or for control. In thirty-four instances a positive reaction was obtained. Of this number thirty were shown to have tuberculosis by other means—*i.e.*, bacilli in the sputum, by autopsy, eye reaction, etc. In two cases the diagnosis of tuberculosis was not confirmed, and two others were shown rather definitely not to have the disease; in them the rise of temperature was probably a coincidence. I have used doses of varying size from $\frac{1}{10}$ milligramme to 6 milligrammes; the dose most frequently employed was 1 milligramme of Koch's T. R. tuberculin. The average temperature reaction in fifteen positive cases with this dose was 103·3° F., reached in thirteen hours. Larger doses caused a higher temperature, which was reached in a shorter time, but seemed to me to possess no advantages. For an infant under six months $\frac{1}{2}$ milligramme is sufficient; for one from six months to three years, 1 milligramme is better. Doses of $\frac{1}{10}$ milligramme I have found rather unsatisfactory, as the temperature may rise only to 101° F. or a little above, so that one may be left in doubt as to its meaning. A characteristic local reaction was observed but twice in 102 injections. I have seen no unfavourable symptoms from the use of tuberculin for diagnosis even in the youngest infants. Its use is, of course, limited to non-febrile cases.

The Diagnostic Value of the Ophthalmic and Cutaneous Tuberculin Reactions.

Calmette's ophthalmic reaction is of very great assistance in the diagnosis of infantile tuberculosis, because of its easy application, and since it can be used in febrile cases as well as in others. In my own experience its results are very reliable even in the youngest infants. In 335 applications of the test in children presumably not tuberculous, not a single reaction was obtained; in two others presumably not tuberculous, a doubtful reaction followed. In only one child proven to have tuberculosis was there no reaction. In this patient three applications gave negative results, although the autopsy showed small tuberculous nodules in the lungs and caseous bronchial glands. The case was one of empyema, with extreme exhaustion and very low vitality. Doubtful reactions were obtained in three children presumably tuberculous. Positive reactions were obtained in the remaining twenty-five tests, and in these children the diagnosis was confirmed by other means as follows: Bacilli in the sputum in eleven cases; autopsy in five cases;

typical reaction, both to skin inoculation and to injection of tuberculin, six cases; and in the remaining three by tuberculin injection alone. In these 368 trials not a single unfavourable effect was seen; care was, of course, taken not to use the test in an eye which was the seat of any form of disease. A 1 per cent. solution was employed in the greater part of the tests.

Von Pirquet's skin test I have employed much less extensively. From my limited experience it has seemed rather less reliable than the eye reaction, though it may be employed when ocular conditions forbid the use of Calmette's test.

XI.

ABDOMINAL TUBERCULOSIS.

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Tuberculosis of the peritoneum, abdominal glands, and viscera, as occurring in early life, merits special study. Tuberculosis of the abdominal organs can occur as a part of a generalized tuberculosis, or as an associated or secondary tuberculous involvement. In each of these instances the clinical part played by the abdominal affection is usually a minor and insignificant one. There is, however, a very definite class of case where the abdominal disease—clinically, at least—is the primary and conspicuous one. Its consideration is one of paramount importance. It is mainly with this class that the present chapter is concerned.

Whilst any of the abdominal organs may be the seat of tubercle, in childhood it is only the affections of the glands, intestines, and peritoneum, with very rare exceptions, that give rise to recognizable symptoms. So much is this the case that, with many writers, abdominal tuberculosis has almost become synonymous with the affections of these last structures. It will be a matter of convenience to follow this course here, and to deal with tuberculosis as it affects the remaining abdominal organs in a separate concluding section. Again, whilst the glands, intestine, and peritoneum may each be the sole seat of the complaint, it will be a further convenience to regard abdominal tuberculosis here as a clinical entity, such as for long has been best known as "tuberculous peritonitis," where all three are involved, except when expressly stated to the contrary.

"Tuberculous Peritonitis."

Age.—So-called "tuberculous peritonitis" is rare under the age of twelve months, some authorities, indeed, asserting that it is practically unknown in the first year of life. Only recently, however, I have seen typical examples of the complaint in infants aged four and six months

respectively, and I have known a few others under a year old. It is not uncommon during the second year, but the incidence reaches its maximum in the third year of life, and then gradually diminishes with each successive year. During the first five years each sex is equally attacked, but in later years there is a large preponderance of cases in girls, the reason for which is not very clear.

Etiology.—That the usual channel of infection is by way of the intestines, and that this can take place when the intestinal mucous membrane is healthy and intact, are both generally accepted. These considerations and the frequency of the presence of tubercle bacilli in cow's milk have naturally led to the assumption that the complaint is mainly one of alimentary origin. But many, including myself, believe that cases where the complaint can be directly ascribed to food, and milk in particular, are far from common, and consider that too much attention has been turned to this source of infection to the exclusion of others. Were milk a frequent responsible agent, it might fairly be expected that cases of abdominal tuberculosis would be extremely common, instead of extremely rare, in the first year of life. That the youngest infants readily respond to other sources of infection is shown by a case of mine, where an infant, that had been suckled by its mother until her death of phthisis when it was a month old, died of general tuberculosis at seven weeks old. The frequency of exposure to, and the rarity of incurrence of the complaint in infancy, and the fact that at times of highest incidence the children have been exposed to other sources of infection, would seem strong arguments against milk being the usual source of the disease. It is stated, too, that in some countries where cow's milk is seldom administered to infants abdominal tuberculosis is more frequent than in this. It has never been proved, moreover, that the complaint is more common in hand-fed children than in those that are suckled, further than the more frequent occurrence of chronic intestinal disorders in the former would account for. The frequency and importance of such other intestinal troubles as factors in the causation of the tuberculous disease is not to be gainsaid. As with tuberculous meningitis, so with the abdominal disorder, a definite history of a blow, more severe than ordinary, immediately preceding the onset of the complaint is far too frequent to admit of the occurrence being lightly regarded as a mere coincidence.

Symptoms and Course.—The complaint presents itself in two forms that are clinically distinct—(1) *the ascitic*, where the symptoms are mainly due to tuberculosis of the peritoneum alone; and (2) *the plastic*, where the mesenteric glands and intestines are involved simultaneously with the peritoneum, each of these structures, perhaps, contributing its own share to the total symptoms of the complaint. Until recent years tuberculous disease of the mesenteric glands as a complaint *per se*

was regarded as exceedingly common, and under the name of "tabes mesenterica" was held responsible for most of the wasting disorders of infants and younger children. Later and more reliable investigations, however, have shown that, except when occurring with disease of the other abdominal organs, tabes mesenterica is extremely rare. That tuberculosis of the mesenteric glands can exist without giving rise to any discoverable symptoms is possible; but it is equally probable, judging from glandular tuberculosis in other situations, that at other times it may be accountable for some degree of irregular pyrexia and wasting. In the early stages of the complaint, when their detection would be of high diagnostic value, the glands are seldom palpable, owing to the accompanying dilatation of the intestines. Later on, however, when the grosser lesions of the peritoneum have made the complaint unmistakable, masses of enlarged glands can be often felt in association with the matted intestines.

Tuberculosis of the intestines never exists by itself, but is always associated with that of the glands and peritoneum. The prominent symptom attributable to it is diarrhœa, and it may be stated that, as a general rule, the amount of diarrhœa is proportional to the extent of involvement of the intestinal mucous membrane. In early stages, however, it may be associated with constipation.

The symptoms arising from the affection of the peritoneum are undistinguishable from those of the entire complaint to which it has given the name. In the plastic form the onset is insidious, and the symptoms in the earliest stages vague and indefinite. As a rule, advice is sought because the child has been growing thin and pale, and the abdomen noticed to be growing larger. In addition, there is generally loss of appetite and some bowel disturbance in the shape of constipation or diarrhœa, or these two last may alternate with one another. Colicky pains are frequent and of great significance when other symptoms are present, but in themselves they may be the first ones of the complaint. Physical examination at an early stage may reveal little or nothing. There is generally, however, some noticeable abdominal distension, and this last may be a marked feature from almost the start. Palpation, too, may reveal areas of abdominal tenderness and some enlargement of the spleen.

In the more advanced stages of the plastic form the physical signs are characteristic and unmistakable. The contrast between the protuberant, dome-shaped abdomen and the wasted limbs and body is a marked and striking one. The skin over the abdomen is thinned, dry, and inelastic, and traversed by enlarged veins terminating at the level of the diaphragm. The umbilical depression may be partially or wholly effaced. The abdominal distension is mainly due to flatus, and may be so great as to prevent any satisfactory palpation of the contained

viscera. When distension is less complete, separate coils of intestine may be felt, and convey to the fingers the impression of being filled with semi-solid material. Hard masses, too, may be felt, mainly towards the lower part of the abdomen, these being due to matted bowel with enlarged glands or other caseous material in the interstices between the intestinal loops. Very often a thickened band of omentum crosses the abdomen from the right flank upwards and to the left, just above the level of the umbilicus. Such bands are pathognomonic of the disease, and should not be mistaken for enlargements of the liver. Any collections of fluid that may be present are usually small in amount, and difficult of detection. In exceptional cases, however, where there are no adhesions of the gut to the abdominal wall, the thickened mesentery may drag the matted intestines into a hard small mass, deep down in the upper part of the abdomen. In such cases the lower abdomen may be filled with fluid in considerable quantity. More often, however, there is no fluid, and the abdomen, instead of being distended in the usual manner, is retracted in the "boat-shaped" fashion. Perforations may occur between adjacent coils of intestine, or into a space between them. In the latter instance an abscess is formed, and such abscesses have a tendency to point at, or in the neighbourhood of, the umbilicus, and may lead to the formation of a fæcal fistula. Abscesses with a similar tendency may result from the breaking down of caseous mesenteric glands. Instead of discharging externally, either class of abscess may open into the gut and the pus be passed *per rectum*. Occasionally, too, inflammatory redness and hardness may occur about the umbilicus, and spontaneously clear up without proceeding further to abscess-formation. In very rare instances, before the abdominal cavity has become obliterated, the rupture of a tuberculous intestinal ulcer leads to a general suppurative peritonitis.

In place of the usual gradual onset the first symptoms calling attention to the complaint may be those of intestinal obstruction, and its real nature only revealed on surgical operation. Apart from intussusception in infants, indeed, in my experience tuberculous peritonitis is the most frequent cause of intestinal obstruction in children.

The first prominent symptoms, again, may be high fever and drowsiness, and the complaint is then apt to be mistaken for enteric fever. Cases like the last may occur in the plastic form, but are more common in the ascitic one, before the effusion into the abdomen clears up the diagnosis.

The general symptoms associated with the local disease are few in number, and are mainly wasting, pyrexia, diarrhœa, and pain.

Wasting, which is a constant feature from the start, may at the end attain such an extreme degree as to be seldom equalled, and never sur-

passed, by that occurring in any other disease, either of children or adults.

The temperature varies greatly, seldom runs high, and in many cases is scarcely raised, if at all. Towards the close, however, it is apt to assume the up-and-down type so characteristic of tubercle in any situation.

Vomiting is most common before the disease has declared itself, and is seldom of any great severity. It may, however, become urgent when symptoms of intestinal obstruction supervene and add greatly to the dangers of the situation.

Diarrhœa in some cases is entirely absent, and in others is present from the start to the finish of the complaint. In early stages it is seldom of any moment, but in later ones it may become so severe as to materially hasten a fatal result. Occasionally the motions contain slight quantities of blood. A history, indeed, of recurring colicky pains, with the occasional passage of blood in the motions, is not an unfrequent one at the start of the disease.

Pain, which is slight and intermittent in the early stages, may in later ones become constant and severe, and one of the most distressing features of the complaint. On the other hand, it is marvellous how little pain is suffered by many children with peritoneal lesions of the severest type.

In the latest stages an eruption of purpuric petechiæ, most marked upon the abdomen, is not uncommon, especially in infants and younger children.

When the disease is well pronounced its course is usually a more or less gradual one towards death, the child dying from sheer exhaustion, or worn out with constant diarrhœa or persistent pain. In some cases, however, improvement sets in, the temperature becoming normal, diarrhœa stopping, and the child gaining weight and strength. The improvement may even extend to the local abdominal conditions, which may become less marked. All evidence proves that such an improvement may be permanent, and that the complaint may undergo a spontaneous cure. My own belief, however, is that the proportion of such cases has been overestimated by some authorities. Only too often an improvement amounting to apparent cure is followed by a relapse after a longer or shorter interval. Improvement, indeed, which stops far short of an apparent cure, is frequent enough. A series of improvements and relapses may make the complaint last out many years.

The Ascitic Form of "Tuberculous Peritonitis."

The foregoing description applies only to the so-called *plastic* form of the complaint. In the less frequent *ascitic* variety the clinical

manifestations have a distinctive character of their own. The onset here is sudden and well marked, and in many instances might be accurately described as acute. After a few days of pyrexia and abdominal pain, more or less severe, the abdomen becomes rapidly distended with fluid. The umbilicus is effaced or protruded, and sometimes the protruded portion is filled with fluid, which can be returned into the general abdominal cavity on pressure. Beyond an occasional increased rate of respiration, owing to pressure on the diaphragm from the ascites, there are usually no other prominent symptoms associated with typical examples of the ascitic form. In very rare instances the pyrexia and pain may persist, and the child rapidly die from fever and exhaustion. Much more usually, however, the temperature drops with the occurrence of the abdominal effusion, and all that remains is a condition of ascites of greater or less extent. If left to itself the fluid is slowly absorbed, and in most cases the symptoms of the plastic form gradually supervene in the course of the next few months. It is exceptional nowadays, however, for the fluid to be left to absorb, for so immediate and marked are the benefits of laparotomy that the operation is seldom withheld. That in many cases the immediate benefits of laparotomy are maintained, and a permanent cure is effected by the operation, is not open to doubt. In others, however, perhaps a majority, the temporary improvement is followed later by intestinal matting and all the other consequences of the plastic form. But even in the last eventuality my experience would lead me to believe that in such cases the progress is slower and recovery more likely than in those which have assumed the plastic form from the beginning.

Pathology of "Tuberculous Peritonitis."

In the *ascitic* form the whole of the peritoneal surfaces are thickly covered with grey miliary tubercles. The abdominal cavity is filled with clear or turbid serous fluid, and there are varying degrees of lymph formation on the intestines and other organs. Any adhesions that may have formed between the coils of intestines, or between these last and neighbouring structures, are recent, and easily broken down. Not unfrequently the abdominal disorder is associated with a similar recent tuberculous affection of the pleuræ or other serous membranes. The onset and distribution are strongly suggestive of the infection being carried by the blood-stream from some caseating focus.

In the *plastic* form adhesions of varying density bind the intestines to one another, and the intestines and stomach may be adherent to the abdominal wall, so that they are opened on cutting into the abdomen. The intestinal matting may form such kinks and bends that it is

impossible to unravel them. Both the mesentery and great omentum are generally thickened and retracted, and, like the adhesions, studded with recent tubercles or larger caseous masses. In extreme cases the intestines, stomach, mesentery, omentum, liver, and spleen are so matted together that they can only be removed *en masse*. Tuberculous ulceration of the intestines is seldom absent, and on separating any more recent adhesions the sites of such ulceration are often indicated by the presence of grey tubercles on the peritoneal surface. Any fluid present is usually small in amount and encysted; it may be clear or turbid serum, but more usually distinctly purulent. Sometimes, on separating the intestines, a larger collection of pus, connected with a perforation of the gut, is opened up.

Diagnosis of "Tuberculous Peritonitis."

In the early stages the symptoms are indefinite, and not usually sufficient in themselves to justify a confident diagnosis. But a suspicion of abdominal tubercle should arise where pallor and wasting in a child are associated with irregularity of the bowels and occasional abdominal pain. This suspicion should be increased if there is a family history of tuberculosis, or if the symptoms have persisted after such complaints as measles or whooping-cough. Although in the early stages with such symptoms there are not likely to be any objective signs, yet, nevertheless, they should lead to a careful examination of the abdomen for any increase of size or areas of tenderness, and to the temperature being taken night and morning for a prolonged period. A positive reaction with Calmette's test is, of course, of infinitely greater assistance here than in the advanced and pronounced complaint.

The fully developed complaint ordinarily offers no difficulty in diagnosis. The contrast between the wasted limbs and the distended abdomen is sufficiently characteristic, and confirmatory signs are usually forthcoming by the discovery, on palpation, of enlarged glands, matted intestines, or bands due to peritoneal thickening. It may be claimed that any movable tumours discoverable in the abdomen of a child are practically either fæcal or tuberculous, and any such persisting after a course of purgatives and enemas are fairly certain to belong to the latter category. In cases where diarrhœa and pyrexia are marked features when first seen, the differentiation from enteric should not be difficult in the light of our present-day knowledge. The wasting is generally more extreme than the corresponding stage of typhoid would account for, and, moreover, marked diarrhœa is an uncommon symptom of the last complaint in children, especially in its early stages. Here again a positive Calmette reaction and a negative Widal one should help to clear up any doubts. It is well to remember in this instance

that rose-coloured spots, indistinguishable from those occurring in enteric and occupying the same sites, occasionally occur in tuberculosis, and there is some evidence that such spots only occur at the last when there is ulceration of the intestines.

Where the symptoms, when the case is first seen, are those of intestinal obstruction, the diagnosis may be extremely difficult, or even impossible, without an exploratory operation by the surgeon. Exceptional cases of intussusception occur without blood or slime in the motions, and where no abdominal swelling can be detected under anæsthesia. Fortunately, abdominal tuberculosis is rare at the age at which intussusception is most common, but I have known more than one abdomen opened for a supposed intussusception where tuberculosis was found. Wasting and a history of previous ill-health may suggest a tuberculous origin of the intestinal obstruction, but the urgency of the case generally allows of no alternative to surgical interference. Occasionally the operation is of service in releasing the intestine from some more prominent obstructing band, but more usually the opening of the abdomen discloses a condition that renders further surgical procedure unjustifiable. Even with the greatest care, moreover, there is a grave risk that the mere opening of the abdomen may lead to a rupture of the intestine or some other abdominal viscus, and this has happened several times with cases under my care. Still, where the diagnosis is necessarily uncertain such a contingency must be faced, rather than allow a child to die unrelieved with a condition that only the operation itself has proved to be irremediable.

Hepatic cirrhosis may closely simulate the ascitic form of tuberculous peritonitis, but the former is an extremely rare disease in childhood. A mistake between the two conditions is of no great moment, because the operation usually performed in the ascitic form of the tuberculous disease would be of no detriment, if not actually beneficial, if done in the hepatic disorder. In one of my cases thrombosis of the portal vein with ascites was taken for abdominal tuberculosis, but I know of no criteria by which the mistake could have been avoided.

By far the most frequent, and the greatest, difficulty in diagnosis occurs in cases of rickets where wasting and intestinal troubles are accompanied by abdominal distension of more than ordinary extent. Here a positive diagnosis may be impossible until the child has been kept under observation for some time. Points of discrimination are that tuberculous peritonitis is comparatively rare at the age at which rickets is most common, the presence of other evidences of the last disease, and the absence of other abdominal physical signs beyond distension. Here, as in other doubtful cases, a Calmette's test may be of service, a positive reaction with a 0·5 c.c., and a negative one with

a 1 c.c. solution, being fairly, but not absolutely, conclusive as to the presence or absence of tubercle.

Prognosis of "Tuberculous Peritonitis."

In some of the later text-books the prognosis is described as favourable, or in even more optimistic terms. With such opinions I can by no means agree, for tuberculosis in any form or situation is a grave disorder in childhood, both in the present and the future. It is true that the abdominal organs are apparently more tolerant of the presence of the bacillus than others, and that improvement is frequent enough under appropriate treatment. But the same improvement is still more marked in cases of tuberculous pleurisy, and yet when kept under observation it is found that a great majority of such cases die in less than three years from the onset of the complaint. There is no reason for believing that permanent recovery is more frequent in the abdominal disease than in that of the pleura. Still, there is satisfactory evidence that in a minority of cases recovery is complete and lasting.

All observers are agreed that the ascitic form is more favourable, or less unfavourable, than the plastic one, and that recovery, in many cases apparently complete, is much more frequent in the former variety. But the absorption of the fluid, or its withdrawal by surgical means, is only too often followed by the plastic condition, with all its ill consequences. Still, the ascitic form marks an early stage of the disease, and there is a reasonable hope that careful treatment after the withdrawal of the fluid may ward off the further plastic changes, and so lead to permanent cure. Marked wasting, prolonged pyrexia, and excessive or protracted diarrhœa, are symptoms of grave import. The older the age at onset, the earlier the complaint is detected, and the fewer the changes discoverable in the abdomen on palpation, the more favourable the prognosis becomes.

Principles of Treatment.

In every case, when feasible, the child should have the benefit of fresh air, either country or seaside, and his life should be spent out of doors as much as possible. If the temperature be raised he should be restricted to a recumbent posture, but this should by no means necessarily entail his being kept in the house. His diet should be light and nutritious, and contain a full complement of fat. To ensure this last the use of cream is preferable to that of cod-liver oil, as the former is equally effective and more palatable to the patient, and less likely to derange the digestive system. The distension of the abdomen is mainly due to intestinal flatus, and for this Dr. Sutherland insists upon the advantage of a diet in which the carbohydrates and milk are restricted, instead of the more "sloppy" ones that are usually advised. Along

with this he gives small doses of castor oil, three times a day, to clear out the bowels. He claims that the benefit of such treatment is speedily manifested in the diminution of the abdominal swelling and the increased comfort of the patient, and I can confirm his views by recent experience in which I have tried this treatment. In a few days after improvement has set in, a gradual return can be made to a diet in which milk and cream have a larger share. Diarrhœa is often difficult to check, and for this purpose a diet that is mainly proteid is often more efficacious than drugs. Of the last I have found a combination of equal parts of salicylate of bismuth and salol more often useful than any others.

In ascitic cases the fluid should be let out by an abdominal incision, and in most cases the improvement is immediate and striking. If in some this improvement is only temporary, in others, there is every reason to believe, it is permanent and lasting. After paracentesis a well-fitting abdominal belt is a comfort and advantage to the patient, and the same appliance can be used with benefit in plastic cases. In these last, except where intestinal obstruction calls for immediate interference, or where an abscess is pointing near the surface, no benefit is to be expected from surgical measures. Where the peritoneal cavity is wholly or partially obliterated, the risk is great that the surgeon will open the gut, with consequences that are far from desirable. In opening an abscess, moreover, merely a simple incision should be made, as any attempt at further exploration may break down adhesions that are occluding a perforation in a neighbouring coil of intestine. All forms of local application of such drugs as mercury and iodoform I have abandoned as useless, if not actually harmful. For the persistent pain of the later stages opium may be called for, and it is astonishing what comparatively large doses of the drug some children will take without contraction of the pupils or any detectable sense of drowsiness.

In the future much is to be hoped for in the perfecting of the more modern methods of tuberculin treatment in all forms of tuberculosis. My experience of such methods in abdominal cases is a strictly limited one, but what I have seen of them in the practice of my colleague, Dr. Clive Riviere, has been favourable beyond expectation.

Tuberculosis of Abdominal Viscera.

Apart from "tuberculous peritonitis," with the exception of the kidneys, bladder, and adrenals, tuberculosis of the abdominal organs is only rarely of clinical importance. As they are dealt with in a separate section, tuberculosis of the kidneys and bladder need not be discussed here.

Tuberculosis of the Liver.

Tuberculosis of the liver is rarely, if ever, a primary complaint. From the nature of its blood-supply, however, it is more often attacked than any other organ in the body, and is invariably involved in tuberculous peritonitis and general tuberculosis. In acute forms of the generalized complaint it may be riddled with tubercles, so minute that the microscope is necessary for their detection. In less acute conditions grey tubercles and caseous masses of varying size may be found scattered throughout its substance. Occasionally the distribution of tubercle takes the course of the bile vessels, and leads to the formation of numerous small cavities containing broken-down liver substance and bile. The capsule is thickened, and the thickening is greatest when the capsule shares in the general affection of the peritoneum in tuberculous peritonitis. The fibrous thickening may extend from the capsule to the septa between the lobes, and spreading thence by way of the portal canals lead to an overgrowth of connective tissue throughout the organ, resulting in a form of hypertrophic cirrhosis, which may be accompanied by ascites and jaundice. Apart from this last rare condition, tuberculosis of the liver gives rise to no recognizable clinical manifestation, beyond one of enlargement. Whether the seat of tubercle itself or not, the predominant condition in all forms of tuberculosis is one of fatty infiltration, as is the case in all wasting diseases of infants and children.

Tuberculosis of the Spleen.

Tuberculosis of the spleen, and thickening of its capsule, occurs under the same conditions as in the case of the liver. The organ is usually enlarged, and the enlargement may be considerable, or so slight as not to be palpable. Even when considerable the associated blood changes are not distinctive, but are merely those of an ordinary secondary anæmia. The splenic enlargement may be the first objective sign of tuberculosis in children, and is hence of occasional diagnostic value.

Tuberculosis of the Stomach.

Tuberculosis of the stomach is far more common in children than is generally supposed. Not infrequently, on post-mortem examinations of cases of intestinal tuberculosis, multiple small tuberculous ulcers are found in the stomach, which were not suspected during life. Any symptoms, such as pain or vomiting, for which the stomach lesions might be accountable are inseparable from those arising from the affection of the other organs involved in the complaint. Such gastric ulceration in the child, however, has been known to give rise to copious and fatal hæmatemesis. It is never found apart from intestinal tuberculosis.

Tuberculosis of the Appendix.

The vermiform appendix is occasionally involved in the tuberculous ulceration which is so frequent in the lower ileum. Some modern authors, moreover, describe a primary tuberculous appendicitis. The symptoms differ little, if at all, from those of the more ordinary complaint, and the true pathological nature of the disease is only discovered on surgical operation.

Tuberculosis of the Vulvo-Abdominal Genitalia.

Tuberculosis of the uterus and its appendages is rare in children, but is occasionally discovered post-mortem, even in infants, usually in cases of general tuberculosis. It is naturally more of pathological than clinical interest.

Tuberculosis of the Omentum.

The omentum is always involved in a general affection of the peritoneum, and in more localized forms of the complaint it may be secondarily involved by the spread to it of the disease in neighbouring organs. In other instances, abdominal tuberculosis is primary in and confined to the omentum. Beyond occasional slight abdominal pain, tuberculosis of the omentum usually gives rise to no noticeable clinical symptoms, and is often first revealed by the more or less accidental discovery of an abdominal tumour. The main characteristics of such tumours are their superficial situation under the abdominal wall, and their extreme motility in most directions. In the course of time the motility may be lost, owing to inflammatory adhesions anchoring the omental mass to some adjacent viscus or the abdominal wall. When this last occurs, the localized tuberculous mass is apt to break down, and lead to the necessity of incision and scraping.

Tuberculosis of the Abdominal Wall.

Tuberculosis of the abdominal wall may occur as a primary complaint, and apart from any similar affection of the peritoneum and other abdominal organs. It gives rise to a semi-elastic feeling swelling which, in my experience, is generally situated in the mid-abdominal line, and more often above than below the umbilicus. On palpation, the mass can be moved along with the skin and the fingers can be inserted beneath its edge in all directions. Except in the event of its suppurating and breaking down, when it can be incised and scraped, it gives rise to no recognisable symptoms.

Tuberculosis of the Pre-vertebral Glands.

Tuberculosis of the prevertebral glands, as a rule, is the result of the extension of the same complaint in the mesenteric and other abdominal glands. Less frequently it is secondary to tuberculosis of

the bronchial or other thoracic glands when the abdominal organs are healthy and unaffected. When they are much enlarged, the glands may form masses of considerable size, which can be felt deep down against the spine in the upper part of the abdomen. For their detection, however, an anæsthetic is generally necessary. Any symptoms for which they may be directly responsible are the same as those arising from tuberculosis of the glands in other situations.

Tuberculosis of the Adrenals.

Any serious affection of the adrenals must be extremely rare, if not unknown, in the course of the tuberculous disease of the other abdominal organs. When associated with Addison's disease, tuberculosis of the adrenals is either a primary disorder or secondary to spinal caries. In the early stages, when active caseation is taking place, the glands may be considerably enlarged and open to detection on palpation, especially if an anæsthetic be employed. At such a stage, however, there is usually nothing pointing to any affection of the adrenals, and before any symptoms of Addison's disease appear the glands have ordinarily become fibrosed and shrunken, and the sites of calcareous deposit. The symptoms of Addison's disease vary widely in the order of their appearance. The patient may be reduced to extremities by progressive asthenia and attacks of vomiting before any discoloration of the skin appears to point to the suprarenals as the site of the malady. In rare instances the patient may even die of exhaustion before any "bronzing" sets in, and the true nature of the disease is only revealed by the condition of the suprarenals on post-mortem examination. In other instances the characteristic discoloration of the skin and mucous membranes is the primary symptom, and may precede all others by a considerable interval.

XII.

ON THE RELATIVE PREVALENCE OF ABDOMINAL AND MENINGEAL TUBERCULOSIS IN CHILDREN IN DIFFERENT COUNTRIES AS SHOWN BY CLINICAL HOSPITAL STATISTICS.

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A GREAT disparity exists in the prevalence of abdominal tuberculosis in children in Great Britain and in America. This has been drawn attention to by one of us in a recent paper.[1] In our present communication we wish to point out (1) the curiously large proportion of children who suffer from abdominal tuberculosis in Edinburgh and Glasgow as compared with the rest of the world, and (2) the marked difference in the relative amount of abdominal and meningeal tuberculosis in Great Britain and other countries.

When we speak, in this paper, of cases of abdominal tuberculosis we refer to those in which the diagnosis is tuberculous peritonitis, tuberculous ulceration of the bowel, or tuberculous mesenteric gland disease, and not to cases of generalized or miliary tuberculosis in which the abdominal affection is present merely as a subsidiary lesion.

The figures we quote are based on statistics, most of which have been very kindly sent us by those in authority in the children's hospitals

[1] Thomson, J.: "The Relative Prevalence of Abdominal Tuberculosis in Children in Great Britain and America," *British Journal of Tuberculosis*, July, 1907. The author regrets extremely that in this paper the percentage of cases of abdominal tuberculosis in the Mount Sinai Hospital in New York was given erroneously as 0·044 instead of 0·35. This does not, however, affect any of the conclusions arrived at.

in the centres mentioned. We bring them forward with a full realization of the inevitable disabilities under which we labour when dealing with the purely clinical statistics of any hospital. Such disabilities are undoubtedly enhanced when comparison between different hospitals is instituted; but, notwithstanding all the drawbacks which must be associated with such a method, we feel justified, in consideration of the very marked uniformity of the returns which we have received, in laying considerable stress on the points brought forward.

In Table I. we show the statistics from British hospitals as regards the frequency of abdominal and meningeal tuberculosis:

TABLE I.—INDICATING RELATIVE FREQUENCY OF ABDOMINAL AND MENINGEAL TUBERCULOSIS IN BRITISH CHILDREN'S HOSPITALS.

Locality and Name of Hospital.	Period in Years.	Total Number of In-Patients.	Percentage of Cases of Abdominal Tuberculosis.	Percentage of Cases of Tuberculous Meningitis.
London: Hospital for Sick Children, Great Ormond Street, W.C.	10	22,896	1·8	1·5
London: North-Eastern Hospital for Children, Hackney Road, E.	10	10,533	1·3	1·4
Birmingham: Free Hospital for Sick Children	10	9,486	1·5	0·4
Sheffield: Children's Hospital	10	3,400	1·3	0·5
Manchester: Children's Hospital, Pendlebury	9	15,795	2·0	0·7
Edinburgh: Royal Hospital for Sick Children	10	15,320	3·6	2·0
Glasgow: Royal Hospital for Sick Children	10	8,619	4·6	2·2
Aberdeen: Royal Hospital for Sick Children	8	5,379	1·2	0·5

From the above table is seen the striking difference that exists between the amount of abdominal, and also of meningeal, tuberculosis recorded in the statistics of the Edinburgh and Glasgow children's hospitals and that shown in the returns obtained from other children's hospitals in the United Kingdom.

Table II. gives the returns we have obtained from foreign and American hospitals:

TABLE II.—INDICATING RELATIVE FREQUENCY OF ABDOMINAL AND MENINGEAL TUBERCULOSIS IN EUROPEAN AND AMERICAN CHILDREN'S HOSPITALS.

Locality and Name of Hospital.	Period in Years.	Total Number of In-Patients.	Percentage of Cases of Abdominal Tuberculosis.	Percentage of Cases of Tuberculous Meningitis.
Rome: University Pædiatric Clinic (Prof. Concetti) ...	12	3,715	0·56	2·3
Toulouse: Clinique Infantile (Prof. Bézy)	10	1,960	0·66	0·56
Montpellier: Clinique des Maladies des Enfants (Prof. Baumel)	5	1,259	0·95	0·7
Lyons: Clinique des Maladies Infantiles (Prof. Weill) ...	13	8,652	0·74	1·05
Bern: Jennersche Kinderspital (Annual Reports)	13	4,205	0·59	0·8
Buda-Pesth: Stefanie Kinderspital (Prof. Bokay)	20	27,173	2·0	3·4
Vienna: St. Anna Kinderspital (Dr. Hamburger)	5	11,184	0·46	2·4
Munich: Universitäts-Kinderklinik (Prof. Pfaundler)	2	1,886	0·42	2·06
Munich: Gisela Kinderspital (Dr. J. Ibrahim)	5	1,635	0·18	1·1
Hagenau: Kinderklinik (Prof. Biedert) ...	10	4,725	0·10	0·12
Christiania: Children's Hospital (Prof. Johannesen) ...	10	2,124	0·99	1·65
Philadelphia: Children's and St. Christopher's Hospitals, and Children's Ward, Jefferson Hospital (Dr. Le Boutillier)	10	18,016	0·14	0·98
New York: Mt. Sinai Hospital, Children's Department (Annual Reports)	9	3,082	0·42	3·9
Boston: Children's Hospital (Dr. H. J. Bowditch)	37	16,031	0·40	1·19

General Conclusions.

It would be unwise at any time to enter very critically into the minutiæ of hospital clinical statistics with the view of obtaining from them definite results regarding definite affections. Such statistics must, however, be accepted as broadly demonstrating the prevalence of the various types of disease treated, and in such a general way it is possible to arrive at certain conclusions.

Thus we find from Table I. that while of 67,489 children treated in hospitals in England and Scotland (elsewhere than in Edinburgh and Glasgow) the percentage amount of abdominal tuberculosis was 1·6, of 68,498 children similarly treated in various Continental countries it was 1·13; and of 37,129 American children's hospital patients it was only 0·28; yet among 23,939 children treated in Edinburgh and Glasgow the percentage was no less than 3·9. In no other centre or centres do the figures even approach those of Edinburgh and Glasgow, the nearest being those from Buda-Pesth, which show a percentage of 2·0 in 27,173 children.

In these two tables we also find statistics showing the relative prevalence of abdominal and meningeal tuberculosis in British, Continental, and American children's hospitals.

From Table I. it seems justifiable to conclude that abdominal tuberculosis is a markedly more common affection, as the main disease, in patients in British hospitals than is tuberculous meningitis. The statistics of only one hospital are opposed to this—those of the North-Eastern Hospital for Children in London, where the cases of tuberculous meningitis slightly exceed those of abdominal tuberculosis.

On the other hand, Table II. shows that the reverse holds good, with very few exceptions, on the Continent, and always, to a very marked degree, in the American children's hospitals. Dr. G. Variot has also informed us that in Paris tuberculous meningitis is a much commoner disease among children than abdominal tuberculosis.

The Manner and Causes of Infection.

We cannot here do more than touch very briefly upon the very interesting and perplexing question of the relation of these statistical results to the manner and causes of primary tuberculous infection in the two different sites. Hamburger,[1] from the results of several hundreds of post-mortem examinations specially undertaken to elucidate this fact, comes to the conclusion that isolated tuberculous infection by way of the intestine practically does not occur in Vienna. He, however, does not conclude that this extreme paucity of cases of isolated alimentary tuberculosis necessarily bears any relation to the fact that practically all the children there drink boiled milk.

[1] Hamburger: *Wien. klin. Wochenschr.*, No. 36. 1907.

Table III. gives figures derived from statistics sent to us by Professor Luigi Concetti, and are of interest:

TABLE III.—RELATIVE MORTALITY FROM MENINGEAL AND PERITONEAL TUBERCULOSIS AMONG CHILDREN UNDER FIFTEEN IN ROME.

	1886–1895.	1896–1905.
Total deaths of children aged 0 to 15 years in the city of Rome ...	41,904	33,807
Deaths from tuberculous meningitis	1,776 (4·2 per cent.)	1,598 (4·7 per cent.)
Deaths from tuberculous peritonitis	1,630 (3·9 per cent.)	1,012 (3·0 per cent.)

In relation to the above, the statement of Spolverini[1] regarding Italian children in his paper read at Brussels, 1907, that "the artificial feeding of infants is extremely seldom employed, and almost never in the poorer classes, where maternal suckling, as being more economical, is the constant rule," is worthy of note.

[1] Spolverini: "Report of Second International Congress of the 'Gouttes de Lait.'" Brussels, 1907.

XIII

TUBERCULOSIS OF THE URINARY TRACT AND GENITAL ORGANS IN EARLY LIFE.

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It may be well to begin by correcting two serious misconceptions widely held by many members of the profession as regards primary tuberculosis of the urinary organs—(1) that it is a disease but little amenable to cure; and (2) that it orginates generally in the lower portion of the tract or in the genital organs.

These errors have doubtlessly arisen from the circumstance that many of our deductions are based upon observations of the morbid anatomy of the disease, as revealed in the post-mortem room, rather than upon clinical investigation. Within the last five years especially there has been an accumulation of evidence to show that tuberculosis of the urinary organs is much more common than we at one time supposed, and that lesions of the kidney and of the bladder may, under favourable circumstances, undergo a process of repair.

Much good may be done while the disease is limited to the kidneys by recognizing the early indications—albuminuria, hæmaturia, or pyuria, each usually small in amount and at first transitory, associated with an acid reaction of the urine, and occurring in young persons with a tuberculous family history. These traces of albumin; little bleedings of which no explanation can be given; small quantities of pus in the urine, but the patient does not complain of any pain in the bladder, perhaps only frequency in micturition or nocturnal incontinence, may all be referred to an early renal tuberculosis. They are the distant signals of danger, and demand prompt and careful inquiry; wait not till the home signals are in full view. More pressing manifestations may soon present themselves, showing that the infective process has extended. By the employment of exact methods of investigation this advance should be anticipated, and means adopted to prevent the disease spreading, if possible; otherwise disaster is almost sure to

follow. To allow time to pass in the hope that the early warnings may be neglected is most unwise, and in the worst interests of the patient. Only within comparatively recent times have we been able to diagnose tuberculous affections of these parts with accuracy, and clearly locate the lesion in the early stage of its development.

Tuberculous Affections of the Kidney.

The kidney may be invaded in four different ways:

1. By the blood-stream. (*a*) The tuberculous particles may be so small as to be stopped only in the ultimate capillaries, where they give rise to numerous miliary deposits (in such instances the blood-stream becomes contaminated while passing through tissues or organs foreign to the urinary apparatus); or (*b*) tuberculosis may arise from infective emboli passing into a branch of the renal artery, the tuberculous virus becoming disseminated over the area of its distribution.

2. By invasion along the lymphatics of the kidney from foci in the lower urinary tract.

3. By contagion along the lumina of the excretory ducts.

4. By spreading to the kidney from continuity with other organs.

In the great majority of cases the invasion is by the method first mentioned. The kidney is invaded earlier, and the lower portion of the tract becomes involved later.

Varieties of Renal Tuberculosis in Childhood.

From a clinical standpoint tuberculous disease of the kidney may be said to manifest itself in three distinct forms, namely: (1) acute miliary tuberculosis; (2) local tuberculosis or renal phthisis; and (3) chronic tuberculous or caseous nephritis. All these varieties are due to the presence of tubercle bacilli and to an infective process resulting therefrom, but the channels through which the virus reaches the urinary tract, and the methods by which local infection spreads, vary considerably.

From a study of statistics the following conclusions may be accepted as regards renal tuberculosis:

1. That miliary tuberculosis is most commonly found in children, whereas the more chronic forms of the disease are rare under twelve years of age.

2. That while caseous nephritis may often be met with in persons of middle age, those most prone to attack are the young.

3. That the older the patient is, the more likely is the disease to be limited in its origin and the process of extension slow.

From the surgeon's standpoint it is very important to distinguish between a disease which involves the whole urinary system and another which primarily attacks an individual organ or part of an organ. With

the distinction just referred to in view Morris[1] shows, by an examination of the records of the Middlesex Hospital, that of the 40 cases of tuberculous kidney met with in 2,610 necropsies, 29 were miliary (secondary) and 15 were strumous (primary). Of the 29 cases of miliary tuberculosis, 18 were males and 11 were females, and in 28 out of the 29 cases both kidneys were diseased; while in the 15 cases of primary renal tuberculosis (nine males and six females), both kidneys were diseased in eight patients. Another point worthy of note is the different periods of life at which the two forms of disease occur. In the miliary (secondary) tuberculosis, 12 cases occurred in persons under ten years of age, eight in persons between the ages of ten and thirty years, six in persons over thirty years of age, and three in persons whose ages were not stated. In the scrofulous (primary) tuberculosis no cases occurred in persons under eleven years of age, five occurred in persons between the ages of eleven and thirty years, seven in persons over thirty years of age, and three in persons whose ages are not stated.

Symptomatology.

In all cases of pyuria and slight albuminuria in children, a careful examination should be made of the genital organs and of the prostate for tuberculous disease, as very often a clue which is of value in diagnosis may be thus obtained. If the symptoms are associated with rapid emaciation, anæmia, elevated evening temperature, and rapidly progessing marasmus, tuberculous disease should be suspected. While the disease is limited to the parenchyma of the kidney, the symptoms may be insignificant and ill-defined; the bladder, ureter, and pelvis not being involved — that is to say, when the infection is purely tuberculous and localized in the kidney—there is seldom much pyrexia, the urine is acid, and the quantity of pus is small.

The only indications of departure from health may be impairment of the general nutrition, indicated by anæmia and emaciation, so that early in the history of the lesion the attention of the physician may not be directed to its tuberculous nature. But in renal tuberculosis, when the mucous membrane of the pelvis or calyces becomes involved, or when abscesses of the kidney burst into them, renal pain becomes marked. It is difficult to make any general statement as to the constitutional symptoms of tuberculosis of the urinary tract in young persons; their characteristics depend not only upon the extent of the disease and the locality involved, but also upon the health or disease of other organs.

It is to the diagnosis of tuberculosis in the early stage that we must especially direct attention, then the aid of the surgeon is

[1] Morris, Henry: "Surgical Diseases of the Kidney and Ureters," vol. i., p. 484. London, 1901.

of some avail. The urine furnishes important information, and in all cases of suspected tuberculous disease in children careful analysis and microscopical examination of it should be made previously to the employment of any instrumental examination. The first indications of a tuberculous lesion in the urinary tract are in children nocturnal incontinence, also frequent micturition and polyuria, due probably to hyperæmia of the organs produced by the presence of tubercle bacilli or their toxins, or to reflex irritation from the bladder. It is a symptom which is very apt to be overlooked and misjudged, unless when associated with albuminuria. The presence or absence of pus seems to depend upon whether or not the tuberculous lesion freely communicates with the urinary tract. If the disease is located in the kidney substance, all inflammatory products are kept shut off and do not mix with the excretion. At the same time, the portion of the kidney not implicated in the disease continues to excrete healthy urine, or urine containing a trace of albumen, but free from tube-casts. Hæmaturia is seldom profuse, but it may occur as a premonitory symptom long antecedent to the development of a gross renal lesion. It is by no means uncommon to meet with cases of profuse and frequent hæmoptyses long prior to the development of any recognizable physical signs of pulmonary phthisis; so also in renal tuberculosis hæmaturia may be present as a premonitory symptom of the disease.

Hæmaturia is often the first indication of danger that induces the parents to seek advice, and in many instances unless repeated and most minute examinations are made, the medical adviser may find it difficult to arrive at a satisfactory explanation of the symptoms. In tuberculous disease the urine presents very marked variations in the different stages of the malady: in the initial phases of the affection the presence of the virus induces a congested condition of the organ, and hæmorrhages occur which are analogous to the early hæmoptysis of pulmonary tuberculosis.

In addition to the diagnostic points already indicated, the detection of the tubercle bacillus in the urinary debris is of great value. It is when tuberculous lesions begin to break down that tubercle bacilli are most abundant, and sometimes their number is very large. Several examinations are required before it can be concluded from negative results that the case is not tuberculous. It is more difficult to obtain the bacilli from urine than from sputum; they are less numerous in proportion to the medium in which they lie, decomposition destroys them more rapidly, and smegma bacilli are apt to be mistaken for them.

One of the methods employed to eliminate the difficulties in the diagnosis between bladder and kidney diseases is a cystoscopic examination of the bladder, including the appearances of the orifices

Treatment of Urinary Tuberculosis.

In those cases in which operative interference is considered inadvisable, the treatment must be symptomatic, the general principle involved being to increase the patient's resisting power. The general constitutional treatment belongs properly to the domain of the physician rather than to that of the surgeon, who can practically do nothing in the way of soothing local symptoms by instrumentation. On account of the great tendency of the urine to become alkaline and to decompose, washing out the bladder is in most instances contra-indicated. The internal use of boric acid, salol, helmitol, urotropin, or benzoate of ammonia, frequently gives considerable relief to vesical irritation; the administration of antipyrin, combined with extract of hyoscyamus, has a similar effect. Strangury may be alleviated by the administration of preparations of opium per rectum, or by the employment of warm sitz baths, and when the urine has become alkaline, calomel administered by the mouth has also a very beneficial effect. Strict attention must be given to all hygienic details, to the careful regulation of diet, and if possible, recourse should be had to a dry and elevated health resort. The advantages of sunshine and fresh air must be realized and applied in all their important details in the treatment of tuberculosis of the urinary tract in children.

Advantage may be gained by the careful administration by hypodermic injection of Koch's new tuberculin, the dosage being regulated by the opsonic index taken at short intervals.

If, however, the disease is limited in extent and the age of the patient permits, a serious endeavour should be made to remove the infected area in the bladder, or if the kidney alone be involved, the excision of the organ may be demanded.

Nephrectomy should be performed as a primary operation, even when the disease does not extend over a large area; there is little hope of success by incision and drainage, also the operation should be performed in cases of strumous disease where nephrotomy has previously been performed, but in which a sinus and discharge persist. Where there is no reasonable prospect of saving useful renal tissue or attaining comparatively rapid spontaneous evacuation, nothing can be gained and much may be lost by delay; therefore, if the general health of the patient be such as to permit nephrectomy being performed, it should be resorted to at the earliest possible date—indeed, whenever it has been shown that the disease is limited to one side.

Slight involvement of the bladder does not altogether preclude nephrectomy, as the bladder lesion frequently heals on removal of the diseased kidney.

When the bladder lane is involved, a suprapubic incision should be made, the tuberculous area curetted, after which the bladder

should be carefully drained, and washed out daily, until the urine is free from tubercle bacilli, as proved by the inoculation of animals.

The writer has had excellent results from this treatment. In all cases the suprapubic drain gives marked relief to the intense pain suffered in many cases.

Tuberculosis of the Genital Organs in Girls.

Primary tuberculosis of the vulva—very rare in adult life—has been seen in children in a few recorded cases, and in these the disease was most probably contracted by infection from tuberculous mothers. Secondary infection may take place in children suffering from disease of the pelvic organs, lesions of the alimentary or urinary tracts, or from disease of bone, and generally appears as small indurated patches, or as flat irregular-shaped ulcers covered by greyish-white sloughs.

Tuberculosis is more frequently met with in the vagina, but even in this region it is rare in children, although more common in young persons than in adults. The structures most commonly attacked in pelvic tuberculosis are the tubes, and probably this affection is more common than generally revealed by statistics, the condition being obscured by the more evident lesions elsewhere; but in the post-mortem room it is frequently found, together with infection of the ovaries, where chronic abscesses are liable to form, and may be discovered as large sacs filled with caseous material.

The subject of tuberculosis of the genital organs of female children has, however, attracted little attention, and the literature is meagre.

Tuberculosis of the Genital Organs in Boys.

Of the male organs, the structure most commonly attacked by tuberculosis in boys is the testicle, but it is less liable to become involved before than after puberty.

In very rare instances it is met with in infants under two years of age, and in young children it assumes an acute form, generally leading to the formation of abscess, the contents of which being discharged, the cavity closes without leaving a sinus. The mesenteric glands seldom become infected, and consequently the prognosis of the disease is more favourable occurring in early life, than when the malady is met with at a later period. Not uncommonly these acute abscesses are regarded as septic in origin, but the presence of tubercle bacilli and the absence of other organisms demonstrate their true character.

In persons under the age of puberty, in the great majority of cases, the infection extends from within outwards, although it may first attack and show itself in the globus major of the epididymis, and extend to the testicle and tunica vaginalis. The incipient character of

the disease and the absence of well-marked symptoms in young persons is probably the reason for the surgeon's opinion not being asked at the very time when he can do most good.

The testicle of a child becomes enlarged, hard, and heavy; the scrotum is unaffected, the veins are not distended, the disease causes little pain or inconvenience, and may be discovered by the parents or the family medical attendant only by accident: it may remain quiescent for months or for years, until some slight injury is received, or till the age of puberty is reached. Then the disease becomes active. It is when the gland naturally increases in size and assumes functional activity that tuberculosis is wont to become assertive.

The epididymis increases in size, small areas soften and form abscesses; these discharge their contents, consisting of ill-formed pus and semen, through one or more openings, which become sluggish fistulas. The scrotum assumes a livid hue, the vas deferens becomes infiltrated with tubercle, and there is considerable danger of the disease extending to the other testicle. The skin of the scrotum may ulcerate, and the testicle protrude as a hard fungating mass partly enclosed in a thin cribriform covering of unhealthy purplish coloured skin.

The great majority of cases of tuberculosis are met with in patients between the ages of twenty and forty years. Russell Howard found that out of 55,912 male patients admitted to the London Hospital, 158 were diagnosed as suffering from tuberculous epididymo-orchitis, and only nine of these were children under twelve. Of 140 cases, not less than 115 occurred in patients between the ages of twenty and forty years. In the nine cases in children the disease was on the left side in four, on the right in two, and in the other three both testicles were diseased, with the left the most affected.

As tuberculosis in young children very frequently escape notice hospital statistics are of little value.

While tuberculosis of the testicle proper is rare, infection of the tunica vaginalis secondary to lesions involving the peritoneum is frequently seen in practice, so much so that in all cases of double hydrocele in children tuberculous peritonitis should be looked for.

The conditions likely to be mistaken for tuberculosis of the testicle are syphilitic orchitis and sarcoma. The former is usually bilateral, involves the body of the testicle rather than the epididymis; it occurs in early infancy, and is associated with signs of congenital syphilis. In sarcoma the disease attacks the testicle in the first instance, usually increases with great rapidity, shows no tendency to degeneration, and is not influenced by medicinal treatment. Extension takes place along the cord, the lumbar glands soon become involved, and abdominal symptoms may appear at an early date from the onset of the malady.

The literature relating to the pathology and clinical features of

tuberculous disease of the genitals is all too meagre, and the whole subject needs more serious study and thorough investigation.[1]

Treatment of Tuberculosis of the Genital Organs.

It is said that in children radical interference is unnecessary when the lesion is limited to the testis, as usually spontaneous cure takes place. This may be true for a time, but is the belief based on accurate observation? is the case followed up to manhood? How often on careful examination in cases of tuberculous cystitis an old long-forgotten testicular lesion is discovered. The tuberculous testicle in the child and young adult is liable to injury, followed by a fresh auto-inoculation. To remove the danger is the safest plan, and the one clearly indicated by the life history of the disease.

When the prostate and seminal vesicles become involved, surgery is rather helpless except by incising abscesses which are liable to form, by slitting fistulæ, scraping out, and draining through the perinæum.

In such cases where the whole uro-genital junction is involved, the progress of the case is generally rapid towards a fatal termination. It is only when the lesion is limited that a cure can be effected by prompt action. Early diagnosis and successful surgical treatment go hand in hand; neglect the former, and the latter becomes helpless.

[1] Students of the subject will find the following references of service:
Allaria: "Primary Tuberculosis of the Generative Organs in a Girl," *Archives of Pediatrics*, New York, vol. xxi., p. 710. 1904.
Bruning: *Monatschrift f. Geb. u. Gyn.*, Bd. xvii., S. 144. 1902.
Corner, E. M.: "Diseases of the Male Generative Organs." London, 1907.
Curling: "Diseases of the Testes," p. 336. 1878.
Demme: *Wiener med. Blatter*, No. 50, S. 1576. 1887.
Fuller, Bangs, and Hardaway: "Diseases of the Genito-Urinary System," p. 236. 1898.
Howard: "Tuberculosis of the Testes in Children," Reports of the Society for the Study of Diseases in Children, vol. vii., p. 125. London, 1907.
Schenk: "Tuberkulos der äussern weiblichen Genitalien," *Beit. z. klin. Chir.*, Bd. xvii., S. 526. 1896.

XIV.

TUBERCULOSIS OF THE EYE IN CHILDREN.

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The infection of the eye and of its accessory structures by the tubercle bacillus is one of the rarer forms of disease to which the eye is liable. If we compare the frequency of the effects of this infection with that of another organism—the *Spirochæta pallida*—which also produces granulomatous inflammations, there can be no hesitation in asserting that tuberculous diseases of the eye are rare, and that syphilitic diseases of the eye are common.

Putting aside for the moment the consideration of frequency, we may similarly compare the seriousness of the effects of the infections of the eye by tubercle and by syphilis; we shall find that there is a fairly well defined difference in the effects of the two invasions. Both are serious, often disastrous, but the manner in which the disaster is determined is different. Numerous children are to be found in our blind schools blinded by the results of syphilitic affections, but it would be difficult to show records where syphilitic disease of the eye, either alone or in conjunction with manifestations of the disease in other organs, had cut short the life of the patient. On the other hand, cases of blindness from tuberculous disease are rare in our schools, but the post-mortem records of our hospitals present many cases where tuberculous affections of the eye, with similar affections of other organs, have resulted in the death of the patient.

A tuberculous affection of the eye is frequently an incident in a life otherwise comparatively healthy. The lesion may be small, run its course, and end in resolution, leaving only a trifling damage to mark the site of the invasion; the lesion may be so severe as to seriously damage the eye, but the fellow-eye may remain unhurt; or the lesion may be of such severity that death leaves no man to tell the tale.

Syphilitic affections of the eye, on the other hand, are of a much more chronic order, and the subjects of the disease have often received them as an inheritance; so there remains for our inspection throughout a life scarcely shortened by the disease the incontrovertible and ineradicable marks of the disease.

I shall consider tuberculous affections of the eye in children under three groups—(1) Tuberculosis of the superficies of the eye; (2) tuberculosis of the anterior uvea; (3) tuberculosis of the choroid. There will be a fourth and concluding section on specific or experimental diagnosis.

Tuberculosis of the Superficies of the Eye.

In Ashby and Wright's[1] well-known manual there is written: "There seems little doubt that anyone living under present conditions in a large city has plenty of chances of becoming tuberculous, and if he does not become so, it is not so much from lack of opportunity as from his tissues being incapable of playing the part of host." Considering the frequent occurrence of tubercle bacilli in the dust of town dwellings, particularly in unsanitary slum quarters, and the constant exposure of the surface of the conjunctiva to dust and dirt, it is remarkable how infrequently this germ is effectively sown upon the mucosa of the eye. In examining the flora of the conjunctiva in healthy schoolchildren, I found[2] as many as twenty-seven varieties of organisms, and many of these were such as we recognize as air-born germs. Neither I, nor any of the other workers who have made similar bacteriological investigations, have found the tubercle bacillus in the healthy conjunctiva, but that it does obtain access to the conjunctiva is evident from those cases where the lachrymal sac is infected without antecedent tuberculous disease of the face or nose. The organism has been washed by the tears from the conjunctiva, where it does not easily take root, into the lachrymal sac, where it can more easily develop. The healthy conjunctiva does not appear to be a convenient soil for the growth of the germ, probably because the slow growth of the germ on any new field of transplantation does not permit of a secure hold being taken on a membrane which is subject to the continual wash of the tears and the repeated sweep of the eyelids.

Three orders of superficial infection are found—(1) Lupus of the lids; (2) tuberculous granulations or ulcers of the conjunctiva; (3) tuberculous disease of the lachrymal sac.

[1] Ashby, H., and Wright, G. A.: "The Diseases of Children," 4th edition, p. 229. London, 1899.

[2] Harman, N. B.: "The Conjunctiva in Health and Disease," p. 41. London, 1905.

Lupus of the Eyelids.

In lupus of the face the eyelids are sometimes attacked; and by reason of exposure, when the protecting lids are destroyed, the cornea may be injured, may ulcerate, and the eye be lost. Such a case as this I have described and illustrated;[1] the figure is, in the words of a reviewer, "ghastly," but so was the case. One eye had gone; even the site of the socket had been obliterated by a covering growth of scar-tissue. The other eye remained lidless and almost sightless, but the disease which had destroyed the lids had not attacked either the conjunctiva or the cornea.

More frequent than these cases, and yet rare in themselves, are cases of tuberculous conjunctivitis. Most of the cases are associated with lupus of the face. The few cases where there is no other local tuberculous lesion are almost certainly the consequence of an injury to the conjunctiva, upon which the bacillus has become implanted.

One case of which I have published a drawing[2] will show well the usual features of these cases. A girl of fifteen years had been affected with lupus of the face for seven or eight years; the glands of the neck and in front of the ear were enlarged. Only one eye was attacked, the one nearer the patch of lupus. There were thereon three separate lesions. In the lower fornix was a long row of cock's-comb-like granulations studded with miliary tubercles; in the depths of the upper fornix was a similar row of tubercles; on the sclero-corneal margin was a patch of velvety granulations; the adjacent cornea was rough and grey, almost in a condition of pannus. The iris was slightly discoloured, but reacted well; the tension was normal, and the fundus healthy; but the vision was reduced to $\frac{6}{18}$. In this case recovery followed removal of the conjunctival granulations with a sharp spoon; they were rotten, and came away like a soft fungoid growth on dead wood. Sections of the growth demonstrated the presence of giant-cell formations, a few acid-fast bacilli, and much degeneration of the newly formed tissue.

A good example of the implantation of the bacillus by injury has been recorded by Jessop.[3] A boy of thirteen years fell and struck the left side of his face; the eye was bloodshot next day. On the third day the pre-auricular gland was inflamed; a month later it was incised, and caseous matter escaped. By the fifth week an indurated hard-edged ulcer had formed on the outer side of the lower eyelid; scrapings from the ulcer were inoculated into a guinea-pig, and caused death of the animal from tuberculosis. By the second month a typical tuberculous conjunctivitis had developed; there were "sago-grain-like granulations" of the fornix and a small raised tubercle of the limbus.

[1] *Loc. cit.*, p. 13. [2] *Loc. cit.*, p. 135.

[3] Jessop, W. H.: Trans. Ophthal. Soc. of the United Kingdom, vol. xx., p. 51. 1900.

An attempt has been made by Sattler[1] to classify these cases into groups: as the conjunctiva is affected in a miliary form or in a papillary form; a variety in which the lids are particularly affected; another for cases associated with a lupoid condition. Eyre[2] added a fifth group to Sattler's four. But, as Greeff[3] remarks, there appears no good ground for making these numerous distinctions; the condition is the same, and more than one variety may appear in the same case. The differences appear to depend upon the duration of the disease at the time of the initial observation rather than upon any difference of inoculation.

Tuberculosis of the Lachrymal Sac.

The third order of superficial inoculation of the tubercle bacillus is that occurring in the lachrymal sac. A considerable number of such cases have been reported. I have seen two during the past year. In these two the nose was free from disease, and in the absence of any local manifestations of tubercle it was presumed that the organism had been washed from the conjunctiva into the sac, where it had found a suitable lodgment. Other cases have been reported where there has been coincident disease of the nasal passages. For example, in the case reported by Vernon Cargill,[4] with an affection of the right lachrymal sac, there was found a tuberculous mass in the floor of the right nostril opposite the nasal duct, and other nodules on the septum and on the wall of the pharynx. The disease spread from the sac to the conjunctiva, and sections of the conjunctival granulations were crowded with tubercle bacilli.

Treatment of Superficial Tuberculosis of the Eye.

The treatment of the superficial tuberculous lesions is in most cases best effected by a prompt excision of the affected tissue. In lupus of the lids excision can only be undertaken when the lesion is small, and where the loss of tissue can be made up so as to reduce distortion of the lids; when this can be done the cure is prompt and permanent. If the lesion has spread from a contiguous larger lesion of the face, we must rely on photo-therapy. In disease of the conjunctiva and of the lachrymal sac there can be no question that excision of the diseased tissue and subsequent insufflation of iodoform is the proper treatment. It is true Stephenson[5] has reported the cure of a case of conjunctival infection by the use of the X rays, but the success of excision is such that the delay and possible uncertainty attendant upon electrical treatment scarcely seem justified.

[1] Sattler: *Ber. d. Ophthal. Ges.* Heidelberg, 1891.
[2] Eyre, J. W. H.: Trans. Ophthal. Soc. of the United Kingdom, vol. xvii., p. 8.
[3] Greeff: "Lehrbuch d. Sp. Path. Anat. (Orth.)," p. 109. Berlin, 1902.
[4] Cargill, V.: Trans. Ophthal. Soc. of the United Kingdom, vol. xx., p. 48.
[5] Stephenson, S.: *Brit. Med. Journ.*, June 6, 1903.

Relation of Phlyctenular Conjunctivitis to Tuberculosis.

Reference must be made to a very interesting and perhaps chronic subject of discussion—the relation of phlyctenular conjunctivitis to tubercle.

The view that there is some essential connection between this form of conjunctivitis and tubercle is a very old one. Mackenzie,[1] describing the disease in 1830, calls it "scrofulous ophthalmia," and says "other scrofulous symptoms may be detected in almost every case of the disease," and then he cites a series of disorders, including joint-disease and tabes mesenterica, which are rarely other than tuberculous. In 1905 I published some results of work on this disease.[2] The following were my findings:

1. It is a disease of children. It does not occur in the first year of life. The cases are most numerous during the fourth to seventh years, with a maximum incidence in the fifth year, the period of decadence of the milk teeth and of chronic oral sepsis.

2. It is a disease of the poor and ill-fed. It is frequent amongst poor native English children; much less frequent amongst Jewish children, even though the latter are much more subject to dirt diseases of the eye. The greater freedom of the Jewish children I associated with their well-fed condition, due to the free use of oil in their food.

3. Of all cases of this disease seen at the Belgrave Hospital for Children during ten years, one-half were cured in one week, three-fourths were well in a fortnight, and all (except a small group of 3 per cent., who developed a severe keratitis) were cured by the sixth week. These are not the marks of a tuberculous lesion.

4. By charting the site of the occurrence of these eruptions in the Belgrave cases, I found that 70 per cent. occurred at the limbus of the cornea in the temporo-malar quadrant, a region that is supplied by the orbital branch of the second division of the fifth nerve, the division which supplies the teeth of the upper jaw.

5. Twenty-three cases were examined bacteriologically: (*a*) The conjunctival sac was found freer from organisms than it is at any other time of life. This I suggested was due to the washing of the membrane by the copious lachrymation. (*b*) The contents of the fresh undamaged phlyctenules were nearly always sterile; of twenty-three cases examined, twenty-one were completely sterile.

From these observations I concluded that the phlyctenule was a herpetiform eruption produced by a chronic irritation of the collateral branches of the fifth nerve in debilitated children, and that it had no essential relation to tubercle.

[1] Mackenzie: "On the Diseases of the Eye," p. 387. London, 1830
[2] *Loc. cit.*, p. 198.

Leber[1] has suggested that the lesion was due to the circulation of tuberculous toxins in the blood apart from their bacilli. This suggestion is based upon the occasional occurrence of crops of phlyctenules after injection of tuberculin.

In 1906 Nias and Paton[2] published the results of an investigation on the tuberculous opsonic indices of a series of phlyctenular cases. In those where there was no demonstrable tuberculous lesion of the body the indices were practically normal. Mayou and Western[3] made a similar investigation and came to a like conclusion.

No one would hesitate to acknowledge that phlyctenular conjunctivitis is likely enough to appear in children the subjects of tuberculous disease, even as it is in those who are ill-fed and debilitated; but I think the evidence I have given indicates that the directly exciting cause is the irritation of the fifth nerve by nasal and oral sepsis in these weakened children.

Tuberculosis of the Anterior Uvea.

The uvea comprises iris, ciliary body, and choroid. Inflammations of the iris, the ciliary body, and the contiguous part of the choroid produce a definite series of symptoms. Since the changes in the iris can be directly examined and are the most evident, these cases are frequently known as 'iritis'; but the evidences of ciliary inflammation are distinctive, and particularly so in tuberculous affections, where the changes are prolonged and gross. The evidence for the coincident affection of the choroid is, as a rule, not found until the eye is examined after its removal; but there are cases where the evidence for the spread of the infection is certain during life.

During the past two years I have watched four cases of this order. A brief note of the conditions and changes seen in two of them will illustrate the nature of these cases.

A girl of six and a half years was seen in September, 1907. There was a rather severe corneal ulcer of the right eye; it started at the upper quadrant of the limbus, and travelled rapidly to the centre of the cornea, where it presented a dense infiltrating appearance. It was considered to be a phlyctenular ulcer of unusual severity. A month later the ulcer was healed, but more serious symptoms developed within the eye. A large grey nodule with fine vessels running over its surface appeared in the iris in the lower and outer segment involving the root region, and there were several small tags of adhesions between the pupillary margin and the lens capsule. On the posterior surface of

[1] Leber: *Ber. d. Ophthal. Ges.* Heidelberg, 1901.

[2] Nias and Paton: Trans. Ophthal. Soc. of the United Kingdom, vol. xxvi., p. 232.

[3] Western: (Discussion) Trans. Ophthal. Soc. of the United Kingdom, vol. xxvi., p. 243.

the cornea were a number of large spots like spots of mutton fat. The details of the fundus could not be seen. The child had swollen glands on the same side of the neck. She had a phthisical family history; the mother had a lung affection, and other children glandular troubles. These appearances were so characteristic that no hesitation was felt in making a diagnosis of tuberculous irido-cyclitis, and directing treatment accordingly. She was sent to the Middlesex Hospital Convalescent Home at Clapton, with the result that by December the eye was quiet, the tuberculous mass in the iris had disappeared, and the child was healthier in every way. But her home was in the low-lying district of the marshes of the River Lea, in Essex, and she returned to hospital in January with a fresh tuberculous growth in the same iris, this time of the inner segment. Another sojourn at Clapton brought resolution of this growth also, and with an arrangement for permanent residence at Margate a complete recovery may be expected.

In this case the evidence for a complication of the ciliary region as well as of the iris is to be found in the precipitates, or "mutton-fat" spots, on the back of the cornea. In an inflammation of the ciliary body the secretion of the glands of that body is altered. It contains leucocytes and fibrin. As the secretion flows through the circle of the pupil into the anterior chamber the leucocytes are deposited on the posterior surface of the cornea, where they are gathered into clumps by the fibrin which collects and coagulates about them. These clumps are merely passive deposits, but indirectly they exert a malific influence on the cornea; the nutrition of Descemet's membrane, both cellular and elastic layers, is affected, so that a slow, degenerative keratitis is set up which has serious effects upon the ultimate vision of the eye, even though a cure of the initial lesion be obtained.

In a case of this nature, reported by Hill Griffiths,[1] occurring in a child, succeeding to the affection of the iris, by one large yellowish growth and a number of minute nodules, there was perforation of the limbus, and the eye had to be enucleated. Iris and ciliary body were found to be deeply affected, but the growth was limited by the posterior fibres of the lens ligament; the optic nerve, retina, and choroid and vitreous were normal. Bacilli could not be found in the growths, but the child died nine months later from a characteristic tuberculous meningitis.

Not all these cases are limited to the anterior uvea. An eye was removed by Mules[2] from a child of twenty-one months for a severe tuberculous irido-cyclitis. The fundus of the eye was found to be extensively affected; not only were there grey masses lying on the ciliary processes, enveloping the lens and filling up the anterior

[1] Griffiths, H.: Trans. Ophthal. Soc. of the United Kingdom, vol. xiv., p. 90.
[2] Mules, P. H.: *Ibid.*, vol. ii., p. 265.

chamber, but in the posterior part of the eye were some thirty white nodules scattered between the disc and the equator of the eye.

Treatment of Deep-seated Ocular Tuberculosis.

The treatment of these cases is one of some difficulty. Early enucleation was formerly recommended; but the recognition of the fact that the affection of the eye is not primary tends to contra-indicate such procedure unless the eye becomes totally disorganized. Rather we have reason to defer enucleation to the latest moment possible, lest the operative measure should replace a local and subacute lesion by an acute general infection. The possibilities of remedial influences of tuberculin injections are always to be kept in view, and in cases I have seen much benefit accruing from this procedure. At the present time I am distinctly impressed with the superior benefit of sanatorium treatment; the complete change of surroundings, of atmosphere, of mode of life, with careful feeding and tonic treatment, have a remarkably successful effect, both upon the condition of the eye and on the powers of resistance of the patient.

Attention must be called to the benefits to be obtained by minor operative interference with these eyes, particularly in cases where there is a turbid aqueous humour and fresh precipitates on the cornea, indicative of much inflammation of the ciliary body. Tapping the anterior chamber is a simple and often useful measure. Felix[1] modified this procedure by simultaneously injecting air into the anterior chamber and withdrawing the aqueous. Haas[2] has published details of six cases treated in this fashion with marked success.

There is a second order of cases of tuberculous affections of the anterior uvea, cases in which there develops a large, massive granuloma of the ciliary region immediately behind the iris. These are very serious cases; the eye is practically always lost. Such cases as those recorded by McHardy[3] and Tatham Thompson[4] are typical of the class. There was evidence of a large inflammatory growth close behind the iris; there was iritis, hyphæmia, marked injection, and bulging of the ciliary region. In McHardy's case the retina was completely detached, and in Thompson's there was a perforation of the ciliary region, but the fundus of the eye remained free from tubercle.

Why there should be this difference in the effects of a tuberculous inoculation of the same region it is difficult to suggest. In one set of cases there is a typical irido-cyclitis, in another a solitary granuloma of the ciliary body, and these shade off into the last class of tuberculous affections I shall notice—the solitary tubercle of the choroid.

[1] Felix: *Zeitschr. f. Augenheilk.*, Bd. viii., 1902.
[2] Haas: *Wochenschr. f. Therap. u. Hyg. d. Auges.*, September 5, 1907, p. 385.
[3] McHardy, M.: Trans. Ophthal. Soc. of the United Kingdom, vol. viii., p. 179.
[4] Thompson, J. T.: *Ibid.*, vol. xviii., p. 172.

Tuberculosis of the Choroid.

Two varieties of inoculations are found in the choroid—(1) an acute or miliary affection, (2) a chronic or solitary lesion.

The miliary form is grave; it is almost always fatal. It is part and parcel of a general tuberculosis, and usually indicates that the cerebral meninges are affected. These cases are almost always under the care of the physician, and are only seen by the ophthalmic surgeon by reference for the examination of the eye. This examination is usually one of great difficulty. The patients are usually children; they are extremely ill; the eyes rove continually, or are turned up under the lids, or are divergent. The greatest patience is needed, and the examination needs to be repeated daily, for the tubercles form very rapidly, and their appearance may only precede death by a day or two.

The appearances of the fundus in these cases has been described by Gowers.[1] There is an excellent drawing from a case by Mules[2] of a girl of ten years, who died of general tuberculosis fourteen days after the "apparent commencement of the illness." Post-mortem the lungs, kidneys, liver, spleen, and the vessels of the Sylvian fissure were dotted with tubercles. Before death eight to ten circular nodules of yellowish-white colour shading off into the colour of the choroid were seen. The nodules were much smaller than the disc, and were deep to the retinal vessels. There was slight optic neuritis. Mules concludes his description of the case with these words: "Taken alone, the ophthalmoscopic appearances are hardly diagnostic of tubercle as apart from other choroidal affections, notably the very early stage of choroiditis disseminata; but, taken in conjunction with other symptoms, they appear to perfect a chain of evidence should there be a link found wanting."

The occurrence of miliary tubercles of the choroid in general or meningeal tuberculosis is now known to be more frequent than was formerly supposed. The figures given by various observers vary widely. Jessop,[3] in the admirable dissertation with which he opened the discussion on intra-ocular tuberculosis at the British Medical Association meeting at Leicester, 1905, reported that at St. Bartholomew's Hospital, of forty-eight cases of tuberculous meningitis in which the eyes were examined post-mortem, tubercle of the choroid was found in fifteen cases, or 31·25 per cent.; of these, six were diagnosed by the ophthalmoscope before death. Carpenter and Stephenson[4] examined forty-two unselected cases of general tuberculosis, and found tubercles in the choroid in twenty-one, or 50 per cent. The lesion is much more

[1] Gowers, Sir W.: "Medical Ophthalmoscopy," p. 198.
[2] Mules, P. H.: Trans. Ophthal. Soc. of the United Kingdom, vol. iv., p. 159 (plate).
[3] Jessop, W. H.: St. Bartholomew's Hospital Reports, vol. xli.
[4] Carpenter and Stephenson: Trans. Soc. for Study of Dis. in Children, vol. i., p. 170.

easily seen post-mortem, for then the overlying retina can be removed. Jessop suggests that, owing to the depth of the tubercle in the choroid, it is not possible to see it during life until there is more or less atrophy of the overlying tissues.

Chronic or Solitary Tubercle of the Choroid.

These cases are, perhaps, of more interest than any of the preceding groups on account of the difficulty attending the diagnosis.

Tubercle affects all the tissues of the body, and there is no reason to suspect any lesser liability for the choroid than for other vascular tissues. Yet the cases of pulmonary or joint disease can be numbered by hundreds, whilst the eye surgeons of widest experience number their cases on the fingers of their hands.

Part of this difficulty arises from the similarity of the changes produced in inflammation of the choroid by dissimilar exciting organisms. It cannot be said that there is any one or essential feature by which a tuberculous lesion can be distinguished from the commoner syphilitic lesion. All that we can say, in the absence of bacteriological evidence, is that the evidence points mainly to one or other infection.

Becker of Heidelberg[1] removed an eye for supposed syphilitic iridocyclitis, yet a choroidal growth 8 by 4 millimetres was found just behind the ciliary region of typical tuberculous structure and containing bacilli; besides, there were smaller tubercles in other parts of the choroid. There was recovery from the operation, but subsequent death from gangrene of the leg.

On occasions the large whitish mass of the solitary tubercle has presented the appearance of a glioma or a sarcoma; but usually the evidences of scleritis are to hand, and indicate an inflammatory lesion.

So far as the symptoms of these difficult tuberculous lesions can be distinguished from other inflammatory or neoplastic tumours, it may be said that solitary or chronic tubercles present one or more rounded, soft-edged swellings of three or four dioptres' elevation, and more often situated in the region of the disc than elsewhere. When in this region they do not greatly affect the vision, and do not cause disturbance of the hyaloid membrane or of the vitreous, so the view of the fundus is unobstructed by vitreous, haze, or opacities. On the resolution of the inflammatory lesion there is not much pigmentary disturbance, certainly not the massive pigmentary collections such as we associate with the healed choroidal lesions of syphilis. Some of these features are modified in cases where there is a lesion in the ciliary region, then vitreous haze is of almost certain occurrence, and the diagnosis is proportionately difficult. The distinctions of these two orders of tuberculous lesions is well shown in the case of the woman

[1] Knapp's "Archives," 1887, p. 434.

I have noted. In the right eye were tuberculous lesions of the fundus and a clear vitreous; in the left eye there was a lesion of the ciliary region, and the vitreous haze completely obscured the fundus.

The residual scars of these choroidal lesions or obsolescent tubercles have been a matter of discussion. In the paper of Carpenter and Stephenson, already referred to, there are figures of scars which would be held by most to indicate rather a syphilitic origin. In two cases which Jessop watched, and had drawn at various stages during the changes of four years, and in which the diagnosis of tubercle was positive, and not a matter of opinion, the lesions healed leaving the barest traces of pigmentary disturbance. For a decision on this interesting point we must await more extended experiences.

The treatment of solitary choroidal tubercle will be largely determined by the view that is taken of the lesion. Is it primary or is it secondary? If primary, then the obvious rational line of action is to excise the eye. The eye is likely to be seriously damaged, perhaps irretrievably, so if this be the sole tuberculous lesion it is best got rid of. So have argued many from Köster[1] to Greeff.[2] To-day the trend of opinion is that these cases are secondary, or at least coincident with other lesions in the body, whether that lesion be demonstrable or not during life. This opinion is based on the evidence of post-mortem examinations; in cases where no second lesion could be found in life it has been found in death. Early enucleation of the eye has given place to the treatment of the general diathesis, and the endeavour to increase the resistance of the infected tissues. Excision becomes the last resort, reserved for eyes that are disintegrated, have ruptured, or are the seat of continual pain. Besides, there is the list of eleven cases collected by Rogman,[3] in which death speedily followed the excision of the tuberculous eye.

Specific and Experimental Diagnosis of Ocular Tuberculosis in Infancy and Childhood.

At the present time there are five means of determining, or attempting to determine, the tuberculous nature of a given lesion apart from its clinical appearances.

Only one of these can be said to afford anything like a certainty of diagnosis.

1. Examination of the aqueous humour or particles of growth from the eye for tubercle bacilli by histological methods would seem the most direct mode of determination. Unfortunately, experience has shown that a positive result is a rare event. This is so even when tissues are examined after death; a typical tuberculous growth may be

[1] Köster: *Centralbl. f. d. Med. Wissensch.*, 1873.
[2] Greeff: *Loc. cit.*, p. 238.
[3] Rogman: *Annales d'Oculistique*, tome cxxx., p. 65.

found, but bacilli are not always demonstrated, although death may have been caused by an indubitable tuberculous meningitis. Lawford[1] only found the bacillus in two cases out of six such cases, notwithstanding the most careful microscopical examination.

2. Inoculation of the aqueous or parts of the diseased tissue into a guinea-pig or into the anterior chamber of a rabbit's eye forms the most sure mode of diagnosis. The process is, however, slow; a fortnight to three weeks are required before the result can be assured. Jessop[2] reported an experiment performed by Watson Cheyne, wherein the anterior chamber of a rabbit's eye was inoculated with a serum culture from the lung of a patient who died of phthisis. In three weeks well-marked tuberculous growths appeared in the iris; these became caseous, and the animal died from general tuberculosis in sixty-six days. Leber[3] transferred caseous matter from a diseased eye to the healthy eye of a rabbit; for several weeks there was no result, then finally typical tuberculous changes were found. Cases are recorded, however, such as that of Samelsohn,[4] where fragments of diseased tissue removed in life did not transmit tubercle by inoculation; yet a positive diagnosis was obtained from examination of the eye after excision.

3. The opsonic index of the patient to tubercle may be examined. It requires to be taken on more than one occasion, lest the coincidence of a positive phase with a single examination give a misleading indication. The test has the advantage of not disturbing the patient, and also of preparing the way for tuberculin treatment.

4. The reaction to Koch's tuberculin is well known. The original preparation I have never seen used. But the new preparation has been used for treatment with results that left no doubt of the nature of the infection.

5. Calmette's ophthalmo-reaction is now quite well known. The interest created by the introduction of this simple test has been great. The literature of the subject has already grown to large proportions. The value of the test is as yet *sub judice*. There is no doubt that a smart conjunctivitis follows the instillation of a 1 or 0·5 per cent. watery solution of Calmette's preparation of tuberculin in quite a large number of tuberculous cases; but it is equally certain that the reaction is obtained in cases that are not suspect of tubercle, and that it does not occur in cases that are certainly tuberculous.

Schiele[5] used the test on sixty-eight patients. Of these, thirty-eight were the subjects of trachoma or follicular conjunctivitis and in good general health, yet twenty-seven gave a "very strong" positive reac-

[1] Lawford, J. B.: Trans. Ophthal. Soc. of the United Kingdom, vol. vi., p. 348.
[2] Jessop, W. H.: *Ibid.*, vol. v., p. 55.
[3] Leber: *Graefe's Archives*, iii., p. 251. 1884.
[4] Samelsohn: *Centr. f. prakt. Augenheil.*, February, 1880.
[5] Schiele: *Wochenschr. f. Therap. u. Hyg. d. Auges.*, p. 73, December 5, 1907.

tion. Parkes Weber[1] states that he obtained a positive reaction from some of his colleagues, who could not be suspect of tubercle when they read hard during the evening succeeding the instillation; and, contrariwise, there were no reactions in some cases of pulmonary phthisis, although bacilli appeared in the sputum.

My friend Stephen Mayou gives me an interesting account of the results of seven tests made from the same tube of preparation. Two were cases of typical tuberculous iritis, but only a bare reaction was obtained. Two were cases of surgical tubercle (one a psoas, the other a sacro-iliac abscess); both gave severe reactions. The remaining three were not suspect of tubercle. A healthy boy gave no reaction; a case of typhoid fever and a case of staphylococcal abscess of the lumbar region both gave severe reactions.

These are a few of the puzzles which require solution before Calmette's reaction can be considered an assured mode of diagnosis of tubercle. It is, of course, possible that cases not suspect of tubercle may have old and quiet foci of inflammation. The frequency with which Kingston Fowler, and many others since the publication of his paper, have found "healed" tuberculous lesions in patients dead from other causes would suggest this possibility. It is also possible, as Weber suggests, that known tuberculous subjects who are refractory to the test are so because they are already loaded with toxin, and a little more is as nothing.

These are some of the features of tuberculosis of the eye as met with in young subjects. It is a subject abounding in interest and in difficulties which call for the nicest judgment both in diagnosis and in treatment, and at the present day demand serious study if in the home and in the school prophylactic measures for the protection of childhood are to be effectively adopted.

[1] Weber, P.: *Brit. Med. Journ.*, February 15, p. 386,; February 23, p. 536, 1908.

XV.

AURAL TUBERCULOSIS IN CHILDREN.

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Long before the discovery of the tubercle bacillus reliable records of tuberculous, often spoken of as "scrofulous," disease of the temporal bone occurring in young children can be found. As early as 1843 Joseph Toynbee[1] observed, and subsequently recorded, cases of "scrofulous disease in the horizontal portion of the mastoid cells in the first year of life, with caries of the squamous bone and disease of the dura mater." Wilde[2] gives a careful representation of tuberculous ear disease in 1853. But it is since the discovery of the tubercle bacillus that greater attention has been given to the special characters of the disease in young children. Probably the first to demonstrate the presence of the bacillus in the secretion from the middle ear was Esche[3] in 1883.

Pathological Considerations.

Tuberculosis of the ear in children is a disease which appears first in the middle ear; subsequently the internal ear is attacked; whilst the external ear, except by the excoriation of discharge escaping by the external auditory canal, is hardly, if at all, affected. Tuberculous ear disease, therefore, is disease of the temporal bone, the disease reaching the tympanum by the short wide Eustachian tube of the young child. The disease commences generally in the first year, and most commonly in the first months of life. At this time the temporal bone consists of three parts—the squamo-zygomatic, the petro-mastoid, and the tympanic ring—and these three are held together by soft connective tissue. There are no mastoid cells except the antrum. Through this soft connective tissue run large bloodvessels, and except towards the sigmoid

[1] Toynbee, J.: "Diseases of the Ear," pp. 303-307. London, 1863.
[2] Wilde: "Practical Observations on Aural Surgery." London, 1853.
[3] Quoted by Politzer in "Diseases of the Ear," English edition, p. 431. London, 1902.

sinus, where the bone is pretty dense, the osseous tissue towards the brain is so soft that it does not long resist the attack which, in tuberculous disease, is made on it from the direction of the middle ear. Intra cranial complications, therefore, are common in middle-ear tuberculosis, and meningitis is much commoner than either abscess or sinus thrombosis.

The effects on the temporal bone and its contents are very profound. The tympanic membrane is early and rapidly destroyed; the ossicles become loosened and are exfoliated; the walls of the middle ear and antrum become denuded of their mucous membrane; parts of the petrous and mastoid portions may become necrotic, and separate as sequestra; the facial nerve, either in its course in the middle ear or in its descent through the mastoid process towards the stylo-mastoid foramen, becomes destroyed. The effect on surrounding structures is also very striking: the dura may become thickened and perforated, whilst the periotic glands become enlarged, and in time soften and break down, forming abscesses; whilst the cutaneous and subcutaneous tissues over the mastoid process may become swollen and infiltrated.

Predisposing and Exciting Causes.

Regarding the ætiology of aural tuberculosis there can be little doubt. It occurs so early in child-life that enlarged tonsils cannot, and still less can the presence of post-nasal adenoids, be considered as common links in the chain of infection, as these undoubtedly are in the infection of the cervical glands of older children. The bacillus reaches the middle ear by the Eustachian tube, or by the subepithelial tissue of the tube. The bacillus may reach the post-nasal space either by means of food, especially milk, or it may be deposited there during respiration.

Clinical Features.

The changes just described produce a very striking clinical picture. There is profuse discharge of a thin, ichorous character in which masses of cheesy or curdy matter may be discovered, or in which gritty particles of broken-down bone may be present. The enlarged glands above referred to are not long absent after the commencement of the disease, and in many cases the facial nerve becomes paralyzed. The skin over the lobule soon becomes excoriated by the irritating discharge, and an obstinate eczema results. These features are constant in tuberculous disease of the temporal bone, and are so seldom present in other diseases that when they occur in young children a diagnosis of tuberculosis is warranted without any search for the bacillus.

Physical Examination.

The otoscopic appearances are scarcely less striking than the signs already described. If a probe be introduced into the canal, it strikes the bare wall of the promontory. Little or no membrane can be seen, except in the earliest stages of the disease, when several perforations may be discovered which by their coalescence destroy the entire membrana tensa. The tissues of the tympanic attic resist the attack a little longer, but ultimately the ossicles become loosened and lost, and in a chronic case nothing can be seen through the speculum of the normal tympanic contents. The walls of the external auditory canal are swollen, and masses of granulation tissue often fill up the lumen of the canal at its inner end. The symptoms of the disease are much less striking than the signs. There is hardly any pain. The subjects of the disease are generally too young to discuss such symptoms as tinnitus or giddiness, or even deafness, but deafness may be discovered if the child is old enough to respond to the usual tests.

Differential Diagnosis.

The diagnosis of the disease is not difficult, but the confirmation of that diagnosis by the finding of the tubercle bacillus is not easy, and may be impossible. In the early stages the bacillus may be found pretty commonly, but in the later stages the infection becomes a mixed one, and the streptococci and staphylococci present so alter the bacterioscopic conditions that the diagnosis may no longer be helped by this kind of examination. The tubercle bacillus has, indeed, been destroyed or displaced. Milligan[1] has shown that the tuberculous nature of the affection can be established with much greater certainty if rabbits be inoculated with some of the mucous membrane and bone which have been removed.

Prognosis.

The prognosis of the disease is, in young children, very bad. Early operation on the temporal bone, before the surrounding glands have become affected and the facial nerve has become paralyzed, may eradicate the disease and save the child. Cases occur in which recovery follows this treatment even when the periotic glands in the neck have become involved and have been removed. On the other hand, such operation may succeed in extirpating the disease from the temporal bone and from the neck, and yet the child may die. In a recent case of the writer's the cause of death was a tuberculous nodule in the pons after all discharge had ceased from the ear and all wounds had healed in the neck. Perhaps the commonest cause of death is meningitis. Generally, the disease destroys life during the first five years, as it is not usual to get well-marked cases amongst school-children.

[1] Milligan, W.: *British Medical Journal*, 1895, and October 12, 1907.

Methods of Treatment.

The surgical treatment consists of the early opening of the mastoid antrum and the thorough drainage of the affected cavities of the temporal bone. Any sequestra should be removed, the soft, broken-down tissue of the mastoid process should be taken away by careful scraping, but little encroachment should be made on the surrounding unaffected bone; and unless the posterior meatal wall be already necrosed, it should be left. No more periosteum should be raised than is quite necessary. During the after-treatment there is a strong tendency to the formation of exuberant granulation masses, and these may have to be curetted from the middle ear and from the mastoid opening. At a subsequent operation any enlarged glands may be removed from the neck, but as soon as possible these little patients should be removed to the country, as they make very slow progress in even the best-appointed hospitals of a large city.

Tuberculous Ear Disease amongst School-Children.

Ear discharges amongst school-children of the poorer classes should be treated, or at least supervised, in school, the ear being washed out and then plugged with antiseptic wool or gauze to prevent the spread of infection during school-hours. Our experience of the treatment of chronic middle-ear suppuration, at the outdoor department of large hospitals, shows that it is useless to expect the home management of such cases to be of any real value. Tuberculous disease of the ear is not common amongst school-children. At the Institution for the Education of the Deaf and Dumb in Glasgow, amongst about a dozen cases of chronic discharge the bacillus was never found, which is not surprising, considering the pathological facts already stated. But the clinical combination of discharge, enlarged periotic glands, and facial paralysis, is also uncommon at the Institution, although the children are almost all drawn from the poorer classes. As it is during the first year or the first two years of life that the disease begins, it is to the early home-life of the child that attention must be directed. A pure milk-supply is of first importance, because it is almost certain that bacilli are deposited about the naso-pharynx from infected milk as the latter is being swallowed.

Prophylactic Measures.

But perhaps of greater importance even than a pure milk-supply is the recognition of the fact that houses of one and two apartments, piled into blocks of four and five or six flats, cannot be rendered fit for the rearing of young children. They are difficult to light, difficult to ventilate, and they cannot be kept clean. Such houses should never exceed two stories in height. When a case of phthisis or other tuber-

culous disease occurs in such a house all very young children should be removed from the dwelling, or the victim of the tuberculous disease should be removed to a sanatorium. When a young child has a suppurating ear, the child, with, if necessary, the mother, should be removed to the country. Small town-houses arranged in flats must be constantly the habitat of the bacillus, and it is certain that the air which young children breathe in such houses is germ-laden, and deposits the bacilli about the mouths of the Eustachian tubes, whence they make their way to the middle ear.

Tuberculosis of the external ear is rare in children; but although it appears rather during adolescence than during childhood proper, its cause is poor feeding, poor clothing, and poor housing during the period of childhood. The disease may take the form of lupus vulgaris, or the milder and more superficial lupus erythematous. The disease is slow in progress and difficult to eradicate, but is to be feared rather on account of the disfigurement it causes than because of its danger to life.

XVI.

TUBERCULOUS AFFECTIONS OF THE SKIN IN CHILDREN.

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CONSIDERING the frequency of visceral tuberculosis in childhood, it is perhaps somewhat surprising that, with the exception of ordinary lupus vulgaris, cutaneous lesions due to the tubercle bacillus are comparatively uncommon. The child's skin is constantly being exposed to minute injuries from tumbles and scratches, and its vitality is apt to be lowered from frequent changes of temperature, the exposed parts naturally suffering the most. If, in addition to these exciting causes, there exists a weak peripheral circulation, with all the morbid consequences which it involves, we have a condition of soil most favourable for the development of such lesions. The saving feature—and it is one to which the child owes not a little—is undoubtedly the ready response of the skin at this period of life to stimulation and to the action of irritants. Vascular dilatation speedily occurs at and around the site of implantation of foreign matter, the morbid products of which are soon carried off by the lymph-stream and deposited in the lymph-glands, there to be ultimately destroyed. When the lesions are due to the development, at certain *loci minoris resistentiæ*, of a toxin already circulating in the blood, and not to the direct action of the tubercle bacillus itself, the case is not quite so simple. The opsonic index will, in all probability, be lowered, indicating a lack of combative power on the part of the system, so that normal phagocytosis is less likely to be successful. Still, it would appear that the skin is not such a favourite site for tuberculosis as other organs.

Classification of Tuberculous Cutaneous Lesions.

The following classification of tuberculous skin affections is modified from that of Crocker:

A.—Those due to the presence of the tubercle bacillus: *Lupus vulgaris, scrofulodermia, tuberculosis cutis (miliary), tuberculosis verrucosa cutis, erythema induratum scrofulosorum* (Bazin), *lichen scrophulosorum.*

B.—Those affections not directly due to the tubercle bacillus, and which have been described as "*tuberculides*" (Darier), or "*para-tuberculoses*" (Johnston): *Lupus erythematosus, acne scrofulosorum, acnitis, the small pustular tuberculide.*

The Bacillary Affections.

Scrofulodermia.—This term is usually applied to those lesions which have their origin in some deep underlying focus, especially a tuberculous gland. It is most frequently met with, perhaps, in association with cervical adenitis. When the skin becomes involved, destructive foci make their appearance, resulting in the formation of a scrofulous ulcer, the edges of which are thin and somewhat undermined, and the base consisting of soft granulation tissue. There is no infiltration, and there are no outlying nodules, but a sinus may communicate between the ulcer and the deeper parts. The cases more often come under the care of the surgeon than the dermatologist.

Tuberculosis Cutis (miliary).—Two forms may be described, one in which the lesions commence around the mucous orifices of the body, and associated with tuberculosis of the internal organs; the other consisting of macular or papular lesions, more or less generalized, and often occurring after measles (Colcott Fox, Adamson). The characteristic bacilli can generally be found in abundance in both types, and inoculation experiments are positive. The lesions of the first type develop into ulcers, and the cases nearly always come to a rapidly fatal end. In a case of the latter, reported by Filia,[1] a child convalescent from measles, there were fifty small, bluish, indolent nodules, many of which suppurated, and inoculation of the pus produced miliary tuberculosis in guinea-pigs. There were no signs of visceral disease; no bacilli were found.

Tuberculosis Verrucosa Cutis (Riehl and Paltauf) is rare in childhood, and when occurring in a single patch is nearly always seen upon the back of the hand. It then presents a very similar appearance to verruca necrogenica. An interesting case of the multiple variety was shown by Graham Little before the Dermatological Society of London in a boy aged two years. The eruption appeared three months after

[1] Filia, A.: "Un caso di Tuberculosi della pelle d' Origine Ematogenica," *Morgagni Revista*, August 4, p. 491, 1906.

measles, and the lesions consisted "of warty excrescences on a red infiltrated base" about the size of a threepenny-piece, situated on the lower limbs, left buttock, fingers, and wrists. Microscopically, the small-celled infiltration and the presence of giant-cells were typical of tuberculosis cutis. Some of the reported cases hitherto grouped in this category must now be regarded as examples of true lupus vulgaris.

Erythema Induratum Scrofulosorum (Bazin).—The tuberculous form of this disease, separated clearly by Whitfield[1] from the non-tuberculous, is distinctly rare in children, though cases of it have been reported in children by White,[2] Norman Walker,[3] Graham Little,[4] and others. In Whitfield's case of a child, aged fourteen, the condition reacted strongly to an injection of the old tuberculin, and she was afterwards cured by the newer tuberculin in association with opsonic treatment. The histology of the patches, which generally occur upon the calves of the legs, is typically tubercular.

Lichen Scrofulosorum.—This eruption is met with in the shape of grouped patches of minute follicular papules, situated upon the sides of the trunk and upper parts of the limbs, non-inflammatory, and without subjective symptoms. Sometimes they bear a small projecting spine, when the diagnosis may be difficult from lichen spinulosus. True tuberculides may coexist with the patches, and its association with other scrofulous manifestations is most marked. The lesions often disappear spontaneously, and they are apt to reappear when the patient's vitality is lowered. Histologically, the "typical structure" of tubercle has been found in fourteen out of seventeen cases examined by Lesseliers, and bacilli have been found by Jacobi, Sack, Wolff, and Pellizari. Positive results have also been obtained with animal inoculation. It is interesting to note that the eruption has been precipitated by injections of tuberculin; in Klingmüller's[5] series of eighteen cases three were produced in this manner. It may be mentioned here that Darier's disease is believed by Hutchinson to be only an exaggerated form of lichen scrofulosorum.

Tuberculides.

Lupus Erythematosus (*Ulerythema centrifugum*, Unna).—This affection is very rare in childhood, but cases have been described by Kaposi,[6]

[1] Whitfield, A.: "A Further Contribution to our Knowledge of Erythema Induratum," *Brit. Journ. Derm.*, vol. xvii., p. 246. 1905.
[2] White, J. C.: "Erythema Induratum," *Journ. Cutan. Disease*, p. 471, 1894.
[3] Walker, Norman: "An Introduction to Dermatology," third edition, p. 225. London, 1904.
[4] Little, Graham: *Brit. Journ. Derm.*, vol. xiv., p. 93, 1902.
[5] Klingmüller, V.: "Beitrage zur Tuberculose der Haut," *Archiv f. Dermat.*, p. 167, 1904.
[6] Kaposi: "Diseases of the Skin," p. 509.

Jamieson,[1] Sequeira,[2] Schamberg,[3] Crocker,[4] and others, in children between the ages of five and fifteen. The latter author has collected from the literature seventeen cases in which the disease had begun between the ages of two and ten. Histologically, the condition is summed up by Robinson as a granuloma, a local infective process, the formation of new reticular or adenoid tissue in the cutis, with marked perivascular infiltration, all pointing to the effects of a toxin "generated *in loco*."

Acne Scrofulosorum.—The lesions in this eruption consist of discrete acneiform papules usually upon the lower extremities. The limbs are nearly always bluish and cold, and the papules themselves are dusky blue, and frequently bear a minute pustule in the centre; they appear in crops, and after a time fade away, leaving scars and pigmented stains. This variety of tuberculide is met with in weakly children, and other signs of tuberculosis, whether of the skin or elsewhere, are often present at the same time.

Acnitis.—Under the name of folliculitis (Barthélemy), this affection was the first to which the term "tuberculide" was applied. It is identical with the small pustular scrofuloderm (Duhring), and Hartzell[5] has shown that the term "papulo-necrotic tuberculide" is more appropriate, for the lesions are not necessarily connected with the pilo-sebaceous follicles. The morbid process starts around the vessels of the corium, gradually coming forward to the surface. Areas of necrosis may be seen, with a few giant cells, but no bacilli. One form of the eruption is limited to the face, neck, and shoulders, leaving small depressed scars (acne varioliformis). Another variety appears upon the hands in the clinical guise of a necrotizing chilblain, and this is the form more commonly seen in children. The usual history in such cases is that the hands and feet are always cold, and that small red areas, becoming bulbous or pustular, make their appearance, and "eat away, leaving scars."

The question may be asked whether there be such a thing as a *tuberculous eczema* occurring in infants. It is true that one frequently sees an eczematous dermatitis of the face in children of the so-called strumous diathesis associated with catarrh of the various orifices, but there is no special reason for assuming that such an eruption is necessarily tuberculous in character. The majority of the cases belong rather to the class of chronic impetigo due to local infection with

[1] Jamieson, A.: *Brit. Journ. Derm.*, p. 115, 1893.
[2] Sequeira, J. H.: "Lupus Erythematosus," *Brit. Journ. Derm.*, p. 368, 1902.
[3] Schamberg, J. F.: "A Case of Lupus Erythematosus in Early Childhood," *Journ. Cutan. Disease*, p. 381, 1906.
[4] Crocker, Radcliffe: "Diseases of the Skin." London, p. 764, 1903.
[5] Hartzell, M. B.: "Some Remarks concerning the Tuberculides," *Medical Record*, New York, 1906, vol. lxix., p. 1012,

pyogenic cocci. An ordinary eczema may, of course, attack a child affected with tuberculosis as well as any other, but there is no more a "hall-mark" of tuberculous eczema than there is of the so-called gouty form.

It has been recently shown by Babes[1] that the tubercle bacillus is able to penetrate the unbroken skin of a guinea-pig readily, without, however, producing any localized infection. Nevertheless, the fact serves to illustrate the comparative ease with which this organism is inoculable, and it would serve to strengthen the old belief that an ordinary eczema might prove a ready channel of infection for tuberculosis. More than thirty years ago Kaposi had demonstrated the importance of trauma as a factor in the production of diseases of the skin, and in the case of true lupoid affections this element plays no small part in their causation. The small pustular tuberculide is not unfrequently found upon the site of some trivial injury or abrasion of the skin.

Chilblains and Tuberculosis.

Erythema pernio may be mentioned here for two reasons. In the first place, we have seen that some of the tuberculides are clinically allied to chilblains. One variety of erythema occurring upon the digits is patchy, symmetrical, and vesication may follow; another type is characterized by its necrotic tendency; while a third might be spoken of as "chronic chilblains," associated with feeble peripheral circulation and nail changes. Secondly, it is generally believed that chilblains are extremely common among the inmates of sanatoria for consumptives, constituting a real source of inconvenience, if not of actual suffering. The question as to whether erythema pernio might not be a tuberculous exanthem was seriously considered by G. E. Permin.[2] Through the courtesy of the medical superintendents of the principal British sanatoria, the writer is in a position to state that 26·6 per cent. of the consumptive inmates are affected with chilblains. Opinions are freely expressed, however, that they are not nearly so frequent in sanatoria as many people seem to think, and some emphatically believe that they have no relationship to tuberculosis whatever. In many cases the members of the staff of such institutions are affected more severely than the patients themselves, owing, doubtless, to greater exposure. They are seldom, if ever, accompanied by other cutaneous lesions, such as lupus erythematosus, and they certainly bear no relationship to the extent or severity of the pulmonary disease. Young patients suffer more severely than old.

[1] Babes, M. V.: "Penetration du Bacille Tuberculeux par le peau intacte," *La Presse Medicale*, No. 48, p. 377. 1907.

[2] Permin, G. E.: "Ist Erythema Pernio (die Frostbeulen) ein Tuberkuloses Exanthem?" *Zeitschrift f. Tuberk. u. Heilstattenwesen*, March, 1904, p. 397.

The treatment is, on the whole, unsatisfactory, and this fact was stated by such a high authority as Lassar. The avoidance of sudden changes of temperature, the wearing of goloshes outdoors in wet or snowy weather, and of woollen gloves, the thorough drying of the hands after washing in warm water, and a plentiful supply of rugs and hot-water bottles, constitute the chief prophylactic measures adopted. Internally, the chloride and lactate of calcium are sometimes of benefit, and also small doses of ichthyol, long continued; while locally, painting with collodion or tincture of iodine, gentle rubbing with compound camphor or belladonna liniment, are useful in the non-ulcerative stages. Alternately plunging the hands into hot and cold water often relieves the itching. Bier's hyperæmia may be induced for eight hours at a time, and its results are warmly praised by some. The X rays have also been applied with benefit in stubborn cases. Ulcerated chilblains require ordinary antiseptic applications.

Cutaneous Hygiene in Childhood.

The sensitiveness of the child's skin, and its ready response to stimuli of every description, indicate sufficiently the lines upon which all prophylactic measures are to be framed. Adequate warmth and protection for the limbs, especially the legs, are of the first importance. On account of the greater risk of injury, shoes and stockings are preferable to sandals, even in summer. Cold or wet feet, especially if borne throughout school hours, are a common source of danger, and the wearing of goloshes in bad weather, even if irksome at first, might well be made compulsory for all scholars.

Baths should be regularly given at least once a day, not too hot, or else the sensitiveness of the skin to cold will be increased. All harsh, strongly alkaline soaps, as well as those containing impure fat, should be excluded, and, if possible, only the superfatted varieties employed. If there be any tendency to eczema, the question of soap altogether becomes of great importance, and it will then be wise temporarily to discontinue it, using bran or fine oatmeal instead.

The finger-nails should always be kept closely trimmed, for if these appendages be allowed to remain long they are not only much more difficult to keep clean, but they become a veritable source of danger, because in the act of scratching, organisms, possibly the tubercle bacillus, may be inoculated.

Attention to all small abrasions, cracks, chaps, and fissures is highly necessary, and these should be gently bathed with some warm antiseptic lotion, and kept covered with cold cream or boracic ointment until healed. In a child predisposed to tuberculosis, no cutaneous injury should be deemed too trivial to receive such care. The use of pins other than safety for fastening the clothing of infants should be

sternly discountenanced. The so-called "traumatic ulcer," often seen upon the heels of children as a result of chafing and friction against the shoes, should never be lightly passed over, for, if neglected, this may become the focus of tuberculosis.

Treatment of Tuberculides.

All the usual measures adopted in cases of tuberculosis which are directed towards the strengthening of the system, thereby enabling it the better to combat the disease, are fully applicable in tuberculous skin diseases. The mere haphazard administration of cod-liver oil, and leaving the rest to chance, will not always do good; indeed, the very opposite effect may be produced to that which is desired. Malt alone, or in combination with cod-liver oil, will generally be tolerated by the infantile stomach better than the latter drug by itself, even if in emulsion form. Quinine and arsenic are also both useful when given internally. An abundance of fresh air, by night as well as by day, together with a liberal and easily assimilable diet, should be supplied whenever possible.

Those varieties of tuberculous skin affections in which ulceration plays a prominent part are nearly always best treated surgically. In other cases bathing with some mild antiseptic lotion, such as creolin (cyllin) well diluted, and the application of a weak mercurial ointment, will be useful. Ten grains of salicylic acid to the ounce of lanoline will clear off an eruption of lichen scrofulosorum effectively. The X rays have proved beneficial in cases of lupus erythematosus, and more recently the electrolytic introduction of zinc or copper ions has acted well in the same affection.

XVII.

TUBERCULOUS LUPUS IN INFANCY AND CHILDHOOD.

By JAMES H. SEQUEIRA,
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Lupus vulgaris is by far the commonest form of cutaneous tuberculosis met with in infancy and childhood. In 53 per cent. of my patients the disease started before the tenth year, and in over 80 per cent. the onset was in the first two decades of life.

Ætiological Factors in the Production of Lupus.

Females are more than twice as frequently affected as males, a fact which has not yet received adequate explanation. It has been suggested that the girl is more in the house than the boy, and therefore more likely to be infected by organisms in dust, etc. Again, there is the possibility that the integument of the male may be more resistant than that of the female. It does appear, in my experience, that children with a delicate "thin" skin appear to be more susceptible; but this is not by any means always the case.

Although not confined to the poorer classes, lupus is much commoner among the children of the indigent and ill-fed than in those in better surroundings. Dirt, bad hygiene, insufficient food, and neglect all have an important influence on the resisting power of the individual to infection, and it is in the children who suffer in these ways that we find the most destructive types of the disease. An examination of the opsonic index of a large number of patients was made by my colleague at the London Hospital, Dr. Wm. Bulloch,[1] and he found that in many it was exceedingly low. We have met with it as low as 0·3, the normal being unity. This indicates a general predisposition on the part of the individual. Local predisposition also plays a part, and certain skins, as I have already mentioned, and certain parts of the integument are

[1] Bulloch, W.: *Trans. Pathol. Soc.*, vol. lvi., p. 334, 1905.

more prone to be affected than others. In 92 per cent. of my cases the face and neck were attacked. This point is of great importance, because, when the disease becomes extensive, grave deformity may result, and this offers a serious obstacle to the patient earning a livelihood in after-life.

Pathological Considerations.

It has been amply demonstrated that lupus vulgaris is caused by the bacillus of Koch. The organism infects the skin—(1) By direct inoculation, a pre-existing breach of the surface being in all probability necessary; scratching and picking by infected fingers being, I believe, a very common source. (2) By direct extension from a mucous membrane already the seat of lupus, as in many nasal cases. Here again infection by the fingers is probably common. (3) By spreading from a sinus leading down to tuberculous glands which have broken down. (4) By similar spread from a sinus leading to carious bone. (5) By softening of some distant focus and escape of tubercle bacilli into the blood-stream. This appears to occur sometimes after acute specific fevers.

The characteristic lesion is a small nodule of apple-jelly or molasses colour. The nodule is non-vascular, and therefore stands out clearly when the suspected part is compressed by a glass spatula or diascope. Microscopically, the lesion has the characters of the tubercle elsewhere, the giant-cell and lymphoid cells. The bacillus is demonstrated in the nodule, but as a rule with great difficulty.

In many cases there is an ulcerative character, and this is especially seen in the mucous membrane lesions and at the junctions of the skin and mucous membrane. In part, this ulcerative type is due to mixed infection, pus-forming organisms being present as well as the tubercle bacillus. As in pulmonary tuberculosis, the destructive process is much more active when there is mixed infection than when the disease is due to the tubercle bacillus alone.

The Localization of Lupus.

In 47 per cent. of my cases the lupus began as a small spot on some part of the face or neck, and in 8 per cent. it started on the limbs or trunk. In all these cases local inoculation was the most probable cause. In about 12 per cent. it was sequel to the breaking down of lymphatic glands, and in 1·6 per cent. it spread from sinuses leading to carious bone.

A point not adequately recognized is the frequency with which the mucous membranes are attacked. Of 964 cases seen in the clinic at the London Hospital, there were mucous membrane lesions in 417, or 43 per cent. The statistics of the Finsen Institute at Copenhagen[1]

[1] Christiansen: *Journ. of Laryngology*, vol. xviii., p. 507, 1903.

show a proportion which is even higher. My late assistant, Dr. Emlyn Jones, tabulates the cases at the London Hospital as follows:[1]

TABLE INDICATING THE CHIEF SEATS OF LUPUS.

Locality involved by Lupus.	No. of Cases.
Nasal mucosa	379
Lips	133
Buccal mucosa and gums	51
Palate	44
Larynx	10
Tongue	4

Lupus was present on the eyelids in 133 cases, and in some of them the disease had spread to the conjunctiva.

In many of the nasal cases we had reason to believe that the nasal duct was affected, as there was marked epiphora.

It is difficult to say in what proportion the disease actually commenced in the mucous membrane, but in many of the nasal cases I believe that this was the case. I have repeatedly had the statement made that the disease was thought to be a "cold" for a long time before the skin was involved, and in many instances there has been a history of epiphora preceding any skin lesion for years.

Manner and Method of Infection.

It is impossible to say in how many cases the disease started as a result of blood infection. My impression is that it is very rare. I have had cases in which there have been from a dozen to twenty separate foci, and some of these have appeared at about the same time. Where there have been numerous impetiginous lesions, I think that local infection may even in this multiple type be the cause. There is, however, one point in favour of infection by the blood-stream, and that is that these cases are most often seen after some acute specific fever. Adamson[2] suggests that this is due to the breaking down of some deep focus—probably a gland—under the influence of the fever, and the infection of the blood-stream. It is difficult, however, to account for the fact that these patients—for there are numerous cases on record—do not die from acute miliary tuberculosis. A point which appears to me also against blood-stream infection is that, of 964 cases, I have not seen one in which the disease started with a focus on the back or on the scalp.[3] These regions possess a covering which is more resistant than that in many other parts, and, moreover, are less liable to direct inoculation.

[1] Emlyn-Jones, H.: *London Hospital Gazette*, February, 1908.
[2] Adamson, H. G.: *Brit. Journ. of Dermatology*, vol. xvi., No. 10.
[3] Cases of scalp lupus due to wound are described in *Deutsch. Med. Wochenschrift*, September 8, 1892, and *Berlin. Med. Wochenschrift*, p. 53, 1895.

Clinical Features.

Lupus, as a rule, spreads very slowly ; but this depends a great deal upon the general condition of the patient, and to some extent upon the nutrition and hygiene. Climatic conditions have a marked influence. For instance, we have all noticed a tendency to activity in the colder months of the year, and especially in the early spring. In a few instances in which a series of observations have been possible, I have found what appears to be a seasonal variation in the opsonic index. I cannot assert this with confidence, as too few cases have been observed. Spontaneous cure of lupus vulgaris is very rare; but it sometimes clears up entirely if the patient should suffer from pulmonary tuberculosis. In patients who have succumbed to phthisis I have seen extensive lupus entirely disappear without treatment. It is noteworthy that lupus is very rarely seen at such institutions as the Brompton Hospital and the Victoria Park Chest Hospital.

Prophylaxis.

It will be obvious that hygiene should play an important part in preventing lupus. Dirty homes, with floors and furniture germ-laden are hot-beds of bacterial infection, and the presence in such a home of a patient the subject of pulmonary tuberculosis must be a constant source of danger, especially to the children crawling about the floors and in contact with the furniture. All measures directed to improving the hygiene of the home would be of the greatest value in combating this as well as other forms of tuberculosis. Attention to personal cleanliness can be inculcated in the schools, and in this respect there appears to be great scope, judging from the condition of the children who attend at the great hospitals in the Metropolis.

Regular inspection of the children in the elementary schools would lead to the detection of the disease in its early stages, when it is, as a rule, easy to combat.

Treatment.

The treatment of lupus has received a great deal of attention of late, particularly since Finsen showed the admirable results obtained by the actinic rays of light. In the Light Department at the London Hospital the technique of Finsen has been carried out with excellent results, no less than 71 per cent. of cures being recorded.[1] In 18 per cent. more great improvement was observed, and the percentage of resistant cases is very small. It must be remembered that a large proportion of the cases included were of long duration and of great

[1] Sequeira, J. H. : "Seven Years' Experience of the Finsen Treatment," *Lancet*, March 7, 1908. See also on treatment—"Light and X Ray Treatment of Skin Diseases," by Sir Malcolm Morris and S. E. Dore. London, 1907 ; and valuable papers in the "Mittheilungen aus Finsen's medicinischen Lysinstitut."

extent. The author's experience of the best lines upon which lupus should be treated is as follows: Cutaneous lupus of small area, and in parts where the character of the scar is of moment, are best treated with the Finsen light. The exception is in those cases which, when first seen, are in an ulcerative condition. In this type it is better to apply the X rays first. These rays have the useful function of healing up ulcers and fitting the surface for subsequent application of the Finsen treatment, which itself cannot be applied to an ulcerated area.

Where the lupus is of small dimensions and on a limb or the trunk, in which cases the scar is of little moment, excision may be performed, as being more speedy. The difficult cases are those in which there is extensive affection of the mucous membranes. Where the lesion can be treated by the Finsen light, good results are obtained. Where this is not available, the X rays are of value; but there is a tendency to relapse. In certain situations the lupus cannot be reached by these measures. When the cavity of the nose is the seat of disease, I have the parts very thoroughly scraped and cauterized. Lesions of the buccal cavity and palate are treated (when not suitable for the X-ray treatment) by regular painting with strong solution of iodine, 1 in 5, or lactic acid, up to 60 per cent.

General tonics are indicated in many cases, and good feeding, and, if possible, change of air. The regular injection of tuberculin[1] (controlled by observations of the opsonic index) has been of some value, but in many cases has proved of little more than temporary benefit. Occasionally we meet with a case which defies all our efforts to effect a cure; but it must be owned that in these the lesions are of long standing and of great extent, and the disease spreads too rapidly for the measures available to cope with it. The author is very hopeful that with the earlier recognition of the disease, and prompt treatment on the lines suggested, cases of extensive lupus, which have proved so intractable in the past, will be very rarely seen.

[1] See on this point a paper by the late Sir T. McCall Anderson, *Brit. Journ. of Dermatology*, vol. xvii., No. 9; and Western, G. W., *Lancet*, November, 1907; also Bulloch, *loc. cit.*

XVIII.

TUBERCULOSIS OF THE CERVICAL GLANDS IN CHILDHOOD.

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THOUGH the seamed and puckered scars, with the unsightly tags of half-living skin, and the collections of dirt and dried discharge which used to mark the old "scrofulous neck," are now happily rarely seen, yet tuberculous disease of the cervical glands is still very common in children. The disfiguring condition to which reference has just been made is, of course, the result of neglect or inefficient treatment; but the absence of such gross mismanagement by no means implies that no fault is to be found with the proceedings of the present day. Tuberculous glands are still often left far too long with inefficient or no treatment.

Pathological Considerations.

It is not necessary to consider here the course of the morbid processes which go on in the lymphatic tissues to which the bacillus of tubercle has gained access; but it is essential to bear in mind the fact that it does not take long for such degenerative changes to take place that complete resolution is impossible. Nor can cicatrization of the affected tissue occur without mechanical removal of the devitalized structures.

No doubt the cervical glands can be infected by direct entry of the tubercle bacillus through the lymph-stream into a previously healthy gland. A second form of infection is that in which a gland is first injured by inflammation set up by the presence of a pyogenic organism which has been taken up by the lymphatics of some surface which has been abraded or otherwise injured. The resisting power of the gland is thus lowered, and the tubercle bacillus finds a lodgement in the previously weakened tissue. Hence the importance of taking the

utmost care to procure immediate healing of all lesions, however trivial, in children whose tissues are suited to the growth of the organism—*i.e.*, those who are not by nature immune. Here it is worth remarking that it is no uncommon thing to find that a child who does not present the well-known appearance of one liable to tuberculosis is yet attacked in this way. Nor is it at all rare for a single member of an otherwise apparently immune family to fall a prey to tuberculosis.

The position may be stated thus: It is unwise to neglect the smallest scratch or cut, or any form of injury, or any possible focus of infection, such as a carious tooth, an enlarged tonsil, an inflamed ear, a sore nose, or a pimple or eczematous patch, or any other source of irritation in any child who is liable to tuberculous infection.

It is also quite unsafe to assume that because a child is a member of an apparently immune family, and is itself apparently in robust health, that it is also necessarily immune.

On the other hand, it must not be taken for granted that all glandular enlargements in children who are likely to be the subjects of tuberculosis are necessarily tuberculous. The swelling may be merely inflammatory, or may be due to other causes, such as Hodgkin's disease, etc.

If we suppose that tubercle bacilli have an opportunity of gaining access to a child who is not immune, it would appear obvious that the lymphatic glands which directly receive the lymph from the point of entry of the organism will be those infected. This, no doubt, is ordinarily the case; and if a gland below the angle of the jaw is found to be enlarged, it is usually a safe assumption that the tonsil is the probable port of entry. This is, however, not always the case, since anatomical variations, blockage of lymph-channels (causing "back-washes"), or the existence of bypaths, or even the possibility of the organism having traversed a gland without lodging there, may all lead to wrong conclusions. Further, there may be lesions of other structures which drain to the same gland. Hence, caution and careful examination of the possible sources of infection, usual and unusual, should be made.

Assuming that the organisms have got a foothold in some gland, it is yet possible that they may fail to survive, and the gland may even, after enlarging somewhat, return to a healthy condition, or it may remain for an indefinite period enlarged and more or less indurated, without undergoing any further marked change or giving rise to any active trouble. But any of the degenerative processes may occur, and mischief may spread to neighbouring glands and surrounding structures in varying degree. The possibility of mixed infections, too, must not be lost sight of. The question is so often asked, "Is there no possibility of this enlarged gland getting well without operation?" that

some rule has to be made—not necessarily an absolutely rigid one—to guide the adviser in such cases. Personally, I think it is a wise thing to fix a period of three months as the limit. If a gland has remained enlarged for three months, even though it has varied in size, it will probably never completely return to a normal condition, but is a source of danger of future trouble, and had better be got rid of. I do not, of course, say that such a gland is certain to break down or is certain to become caseous, but I think it is generally so much injured that it is better removed as a likely source of further mischief. It may itself break down; it may be a source from which extension to adjacent parts takes place; or it may be a focus from which a general tuberculous infection occurs.

Differential Diagnosis.

Something has already been said about the diagnosis of tuberculous disease of glands from other glandular lesions. The difficulty is not very often a great one, though in a certain number of instances there undoubtedly is a difficulty. The most common doubt is whether the mischief is simple—*i.e.*, due to one of the ordinary pyogenic organisms—or not. In the simple form the process is usually more acute, the source of infection is obvious, and the child is not a likely subject of tuberculosis. Subsidence or suppuration usually speedily takes place.

The enlargement of glands due to syphilis, to secondary deposits from malignant growths, or to such conditions as Still's disease and lymphatic leukæmia, need only be mentioned. Hodgkin's disease and the more localized lymphomata or lympho-sarcomata require consideration. Probability is all in favour of tuberculosis, as it is far the more common condition. In Hodgkin's disease there is usually no focus of infection to be found, and there is a more generally widespread enlargement of glands in various parts of the body. The enlargement varies in degree, often rapidly and greatly. The constitutional symptoms and irregular or periodic rises of temperature soon appear, as well as visceral enlargement, and it is rare for the gland to break down. The glands reach a large size, and remain free from any peri-glandular inflammation, and so do not become fixed. These features will usually serve to suggest that the lesion is not a tuberculous one, though undoubtedly tuberculosis and Hodgkin's disease may coexist, even if there is no closer relationship.

The other form of lympho-sarcoma is usually at first localized, but it rapidly reaches such a size as to exclude the possibility of tuberculosis; so that it is only in the earliest stages that a doubt can arise.

Treatment.

The treatment of tuberculosis of the cervical glands consists in the removal of all sources of irritation as a first step, so that the resistance of the tissues may not be lessened and so that the dangers of a mixed infection may be minimized. Next, means should be taken to avoid exposure to infection by tubercle, and to increase the child's power of resistance by improving its surroundings and management. Finally, the question of the need for operation has to be settled. A standard of time has already been mentioned, and it has been suggested that any gland that has been enlarged for three months should be removed. This rule should hold good even if the gland has varied in size, for although much of the swelling may have disappeared, the persistence or recurrence of enlargement means as a rule that a return to health is impossible, and that a focus of disease exists that is beyond resolution.

It is of the greatest importance that the glands should be removed before there is any extensive peri-glandular inflammation, which causes matting and adhesions to surrounding structures, and often actual infiltration of the tissues with tuberculous material. *A fortiori*, it is essential that the glands should not be allowed to soften and break down before removal. If this has occurred, the operation is made much more difficult and severe so far as the mechanical process is concerned, and there is great risk of the wound becoming infected during the operation either with tuberculous or septic matters, and so delayed healing and a worse scar, if not an extension of the disease, is a likely result. Though as a routine it is urged that early removal of the glands should be practised, yet there are certain exceptions. For instance, it is obvious that if there is general tuberculosis, or there are other important foci of tubercle in viscera or bones or joints, the presence of the glands may be of minor importance, or the child's health may preclude any operation. There is, however, another class of patient in whom operation is undesirable. Occasionally, after an operation for removal of tuberculous glands, although all palpable glands have been satisfactorily taken away, within a few weeks other glands in the neighbourhood are found to have become enlarged. In such cases it is wiser not to operate again, but to devote attention to improvement of the powers of resistance by change of air and such general measures as are part of the familiar routine of treatment of tuberculous children. Often, after a visit to the seaside, the recently enlarged glands will subside, and even if they do not disappear the conditions are more favourable for successful operation at a later date.

There are certain risks in operations upon this region which are obvious, but have to be taken into account, such as injuries of important vessels and nerves. Of the latter, the vagus, the spinal accessory, and the lower branches of the facial are the most important. Injury to

muscles such as the sterno-mastoid and trapezius, either directly or by division of their nerves, may lead to atrophy, with disfigurement, and perhaps secondary spinal curvature. An unsightly scar may follow an ill-planned or carelessly sutured incision, and it is well to emphasize the fact that late operations which require drainage necessarily leave more conspicuous cicatrices. Incisions should be planned as far as possible to follow the lines of natural folds, and so be as little visible as may be. The edges of the incisions should be sutured as accurately and neatly as possible. The high transverse incision does not commend itself, and after trying it and seeing one or two examples of it, the writer is not inclined to recommend it. Incisions under cover of the jaw, or along the anterior or posterior borders of the sterno-mastoid, give sufficient access, without any serious disadvantages. Division of the sterno-mastoid can hardly ever be necessary for removal of tuberculous glands, though it may be required for malignant disease. Removal of part of the internal jugular vein is occasionally required, and does no serious harm. Infected skin should always be removed. In cases of tuberculous disease of the glands on both sides, or very extensive mischief on one side, it may be wiser to divide the operation into two stages, and not to subject a delicate child to a very prolonged operation. In such cases an interval of a fortnight or three weeks, or even longer, may be judicious. When the glands have been left to caseate and break down, the removal may degenerate into a mere scooping or scraping operation; but even then it is well to dissect out any solid portions of diseased gland as far as possible. In such conditions it will be found that sometimes the gland contains fluid closely resembling pus, and in others soft caseous material, while in yet other instances a firm, solid yellow substance, almost like the consistence of a chestnut, can be scooped out, and a thin, apparently healthy, capsule left. In all instances where a superficial "abscess" exists search must be made for the underlying gland, in accordance with the observations of Teale. If this is neglected, a persistent sinus will remain, and bring discredit upon the operation. It is a very familiar experience to those who do much of this work that an operation appears likely to be a short and simple one, involving only the removal of a single gland; but on searching beneath the muscles mass after mass of glands appear, and the affair of a few minutes becomes an operation lasting an hour or more. It is therefore wise to be cautious in specifying either the duration or extent of proceedings. After the completion of the operation it is well to use a liberal amount of dressings to pack round the neck, and to secure them well by turns of bandage under each arm and around the head. The head should then be secured and fixed by sand-bags or a sawdust collar, or some similar appliance, to prevent movements, which would impede healing of the wound. Further

details of wound-management need not be entered into here, but in conclusion it may be said that some of these children with tuberculous cervical glands are very suitable cases for treatment by tuberculin inoculations. Masses of caseous material will not, of course, be affected ; but in rapidly recurrent enlargement, and in conditions where the disease is not very far advanced, it is well worth while to consider the method, and excellent results will sometimes be obtained from its use with due precautions.

XIX.

TUBERCULOUS DISEASE OF BONES AND JOINTS IN CHILDHOOD.

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THE pathology of tuberculous disease, as it affects the bones and joints in early life, is comparatively simple. Tubercle bacilli obtain entrance into the body by one or other of various channels, probably in most cases by the alimentary canal. In many cases it is probable that carious teeth afford the channel of access. The bacilli, once in the tissues, settle down in any weak spot which affords them opportunity for development.

General Pathology.

Joints and bones, especially if they have recently been the seat of some slight injury, are very likely indeed in young subjects to become the seat of tuberculous disease.

In the cases of bones, although *any* bone and *any part* of it *may* become the seat of tuberculous disease, yet it is cancellous tissue that is far more prone to be affected than compact tissue. Thus, the cancellous ends of long bones, and short bones such as the vertebræ, and those of the carpus and tarsus, are most liable to the disease. The shafts of long bones, and bones such as those of the vault of the skull, which contain but little cancellous tissue, are but rarely the seat of primary tuberculous disease. The neighbourhood of the cartilage between epiphysis and diaphysis is also a favourite seat of tubercle.

As regards *joints*, tuberculosis may begin in the synovial membrane itself, and spread thence to other parts of the joint. The knee-joint often affords a good example of this. Here, in many an early case of tuberculous disease, the whole synovial membrane will be found greatly swollen, forming a thick, pulpy mass readily accessible to sight and touch, before there is any obvious affection of either bone or cartilage.

In many cases, however, it is the bone itself underlying the articular

cartilage that is the starting-point of the disease, the actual joint surfaces being affected only secondarily by extension.

Movements of the joint favour the progress of the disease, probably by causing minute mechanical injuries, which afford opportunities for the further dissemination of the bacilli.[1]

As soon as the tubercle micro-organisms have settled down in the affected region, of bone or joint as the case may be, Nature sets to work to neutralize their injurious effects. This is done partly by producing a spontaneous immunization, and partly by walling off and shutting up the tubercle bacilli, which the leucocytes then do their best to destroy.

In the bones a slow process of surrounding osteitis leads to local thickening from deposition of new bone. Necrosis occurs but rarely, and when it does the sequestra are usually quite small, very unlike the extensive sequestra so often seen as the result of acute pyogenic infections of long bones.

Tuberculous sequestra are perhaps best seen on the articular surfaces of joints. In the shaft of a long bone it occasionally happens that a small tuberculous sequestrum leads to the deposit of a large mass of surrounding new bone, without suppuration. On the other hand, in cancellous disease the tuberculous bone may break down and form an abscess cavity, with or without the accompaniment of a small sequestrum.

In the case of a joint, abscess may originate in the soft tissues immediately outside the joint, and remain unconnected with the latter. More commonly, however, the suppurative process commences in the joint, and makes its way through the capsule into surrounding tissues.

The later stages of tuberculous disease of both bones and joints is generally complicated by the presence of micro-organisms other than tubercle bacilli.

Especially when external suppuration has occurred, and septic sinuses are present, is there a marked tendency to rapid destruction both of bone and of soft tissues. Joints become more and more deformed, bone and soft parts tend to crumble away under the destructive influence of septic micro-organisms, and, finally, infective pathological changes become manifest in the liver, kidneys, and other viscera.

Unlike most of the more acute forms of arthritis, tuberculous disease, except in the case of the spine, affects, as a rule, but a single joint. Occasionally, however, two or even more joints are affected at the same time. In children it is a remarkable fact that tubercle of

[1] Koenig, among 137 cases of tubercle of the elbow-joint, found that the disease began in 29 per cent. of cases in the synovial membrane, in 71 per cent. in the neighbouring bone. See Wilms, in "Bergmann's Handbuch d. prakt. Chirurgie," vol. iv., p. 227. 1903.

the lungs seldom coexists with tuberculous joint disease—at any rate, in the absence of mixed infection.

At almost any stage of tuberculous disease of a bone or joint, especially under appropriate treatment, arrest of the destructive process may occur. The tubercle is destroyed, or completely shut up and localized; repair takes place both in bone and soft tissues, and the patient recovers with a more or less damaged bone or joint.

It is well to remember, however, that the seeds of tubercle may, in such a case, lie dormant for years, ready to spring up into activity at any time, especially as the result of injury or fresh infection. The activity of such tubercle is, as a rule, not very great. The suppuration which occurs under these conditions is usually exceedingly mild The "residual abscess," as it is called, is notorious for the slightness of the symptoms it produces, and is praiseworthy for the satisfactory manner in which it heals up after careful and aseptic evacuation of its almost sterile contents.

Symptomatology.

Tuberculous disease of bone or joint being essentially a chronic process, it follows that the symptoms tend to be chronic or subacute rather than acute.

Essentially a local process, it is upon local evidence of disease rather than upon general symptoms that we must depend for the diagnosis of tuberculous disease of these parts. Take the case of a tuberculous dactylitis. The bone slowly swells, but pain and other ordinary signs of acute inflammation are conspicuous by their absence; constitutional symptoms are wholly absent.

With joints, too, a painlessness and chronicity are often for a long time marked features of tuberculous disease. The concomitant inflammation of joint surfaces, and especially the irritation caused by the movement of inflamed surfaces upon one another, does, however, often cause acute symptoms, of which severe pain may be one of the most prominent. Spasm of muscles, local pain, and tenderness, often referred pain as well, together with rapid wasting of the muscles round a joint, are the common signs of the earlier stages of a tuberculous joint.

If the joint be not kept at rest, if active disease be going on within it, if the articular ends of the bones be exposed by ulceration, and, above all, if there be a mixed infection in the joint, then severe pain is likely to be a prominent symptom.

Loss of movement in the joint, and a tendency to assume some fixed position, generally one of partial flexion, are the almost invariable accompaniment of the disease, even in its earlier stages. Later on, when destructive changes have taken place within the joint, there may

be great deformity, due to actual displacement of the articular surfaces from one another.

The symptoms of suppuration in connection with tuberculous joint disease differ very much in severity in different cases. If suppuration occur under conditions of tension, as beneath the articular cartilage or within a tensely distended synovial membrane (*e.g.*, in the hip), there may be a good deal of dull aching or even severe pain, often suddenly relieved when the abscess has made its way into surrounding soft parts. Constitutional symptoms of septic absorption, too, are often present in such cases.

The more ordinary tuberculous abscess, however, that forms slowly while the joint is kept at rest, does not, as a rule, cause much pain or constitutional disturbance. Frequently the only evidence of such an abscess is the presence of a soft elastic swelling in the neighbourhood of the joint. The very painlessness of such abscesses, and the slightness of the signs and symptoms to which they give rise, frequently cause them to be overlooked by the unwary or the inattentive.

In deep-seated regions especially, such as the loin (in connection with spinal caries), the popliteal space, the axilla, or the neighbourhood of the hip, tuberculous abscesses often attain considerable dimensions before their presence is even suspected.

The abscess of mixed infection may cause any or all of the signs and symptoms of acute suppuration.

In those rare cases in which tuberculosis attacks primarily the shaft of a long bone, the diagnosis from other forms of periostitis, and even from malignant tumour, may be difficult.[1]

Principles of Treatment.

The object of our treatment should be to get rid of the tubercle, and at the same time to damage the affected bone and joint as little as possible.

Much assistance may be afforded to the tissues in their endeavour to destroy the tubercle bacillus by general hygienic measures, such as a good wholesome diet, including plenty of milk and cream ; abundance of fresh air ; warm clothing ; avoidance of constipation, etc.

The room or ward in which the child lives should have its windows kept constantly wide open, so that plenty of fresh air may circulate freely.

At the Alexandra Hospital for Children with Hip Disease, in London, not only is the above principle carried out very fully, but we

[1] Thus, I have seen a clavicle excised by a well-known hospital surgeon for what was thought to be periosteal sarcoma, and which had caused spontaneous fracture. The tumour proved, however, to be primary tuberculous disease of the shaft of the bone. The difficulty of diagnosis between tuberculous and other forms of periostitis of the shafts of long bones is well known.

also have large open-air balconies on which as many of the children as possible are kept day and night, summer and winter, much to their advantage. Care is taken that their hands and feet are kept warm, and it is remarkable how seldom these children suffer from catarrh, and how little they mind the cold and exposure, even in winter.

Residence in the country or at the seaside is also an advantage to a child with tuberculous joint disease, provided that it is possible to carry out at the same time the mechanical and other surgical treatment that may also be necessary. The institution for tuberculous disease at Berck-sur-Mer, in France, carries out these principles with good results, as do also the numerous convalescent and other homes at many of our seaside resorts in England.

The careful employment of tuberculin is also of value in the treatment of the disease, especially in its earlier stages. The dose employed, to begin with, should be extremely small.

In cases where there are open wounds infected with staphylococci and other organisms it is found that the injection of an appropriate serum often leads to rapid healing of the wounds.

The hyperæmic treatment recommended by Bier is probably also not without value, and represents yet another method of endeavouring to effect a direct destruction of bacteria.

Besides the above general and bacteriological treatment of the disease, local treatment is of the utmost importance.

Of disease limited to the bones but little need be said. If suppuration exist abscesses must be evacuated, sinuses laid open and cleansed whenever practicable.

Local scraping and gouging away of tuberculous bone is often of benefit. Occasionally excision of bones is desirable, and even amputation may become a necessity in extreme cases.

With regard to joints, one of the most potent influences for good is rest for the affected joint—*prolonged and complete rest.* If the affected joint be kept rigidly at rest from the beginning of the disease, the tuberculous process will, in nearly all cases, be arrested and the patient cured.

Much of the surgical treatment of tuberculous joint affections consists in applying means by which the joint obtains this much-needed rest.

For joints of the upper limb a mechanical support, in the shape of a splint of one kind or another, affords the best means of ensuring the necessary rest without confining the patient to bed. Wood, leather, gutta-percha, poroplastic felt, plaster of Paris, metal, and numerous other materials are employed to form the many well-known varieties of splint.

For joints of the lower limb, and for the spine and pelvis, splint

treatment alone is seldom sufficient. Prolonged rest in the recumbent position for months, or even years, is generally necessary for the efficient treatment of these joints—at any rate, of the larger ones among them. The well-known principle of weight extension is particularly valuable in the case of acute disease of the hip and knee.

For tuberculous disease of the tarsus, ankle, and knee in its less severe forms, however, it is often possible to completely immobilize the affected joint by means of mechanical apparatus. The patient may then be allowed to get about on crutches.

For tuberculous disease of the hip and spine, during the acute stages, and for long afterwards, the so-called ambulatory forms of treatment are, in the opinion of the writer, not permissible if the best results are to be obtained. It is all a question of rest, and efficient rest cannot be given to these larger joints while the patient is going about.

The principle of trying to get rid of all the tubercle in a joint by excision or erasion of the joint, although fashionable a few years ago, is now fortunately being pretty generally abandoned. Although often producing for a time an apparently brilliant result, yet it seldom attains its aim effectually and permanently. It certainly exposes the patient to considerable risk, and it almost necessarily leaves the patient more seriously crippled than he would otherwise have been. Those who are in the habit of frequently seeing such cases of arthrectomy or excision years after the operation has been performed can perhaps best appreciate the evils produced by such operations when they see the distorted, shrunken, weakened, and atrophied limbs so often left thereby. It must be remembered that this article deals with the joints in *childhood*, for it is in the growing limbs of children especially that excision and erasion are so often pernicious in their after-results. As a general rule, the younger the child the less permissible are these large joint operations.

There are certain cases of extensive, but not very acute, tuberculous disease, especially of the knee and elbow, in young adults, which may with advantage be treated by excision or erasion.

Coming now to the treatment of suppuration in connection with tuberculous joint disease, we must remember that an abscess is one of Nature's methods of getting rid of more or less dead tuberculous material. It is of the first importance that the surgeon, in dealing with such an abscess, if purely tuberculous, should not produce a mixed infection. The danger of doing this is so great that some surgeons recommend that these tuberculous abscesses should not be opened so long as it is possible to avoid doing so, and even then prefer to make use of an aspirator rather than a knife. There is much to be said for this practice. It is probably better, however, on the whole to open a tuberculous abscess as soon as it becomes reasonably accessible, to

scrape out the tuberculous matter that lines it, and then to close it completely, if possible without drainage. It cannot be too strongly laid down, however, that in opening these tuberculous abscesses just as much scrupulous care should be exercised as regards rigid asepsis as in the cleanest of operations.

In some cases it is permissible to open the abscess freely, to pack it with gauze, and to treat it then as an open wound, with strict antiseptic precautions as before.

In those cases where a mixed infection has already taken place, closure of the wound is, of course, inadvisable. Drainage or open treatment must be adopted. No scraping of the wall of the abscess is permissible in these cases. The practice of introducing iodoform emulsion or other antiseptics into the abscess cavity is recommended by some, but has been completely abandoned by the writer after a fair trial of the method.

In some cases and in some joints it is permissible to scrape or gouge away tuberculous bony tissue, but as a general rule such a practice should be avoided. If there is reason to believe that sequestra are present, an attempt should, of course, be made to remove them.

In the later stages of tuberculous joint disease, when septic sinuses are present, the object of treatment should be to render and to maintain them as clean as possible. Whether they should be laid open or not depends largely upon their situation, number, and extent, the amount and nature of the discharge from them, and the depth of the joint with which they are connected.

When necrosis of bone is known or suspected to exist (the amount of suppuration and a skiagram will often afford important information on this point), large operations for its removal may have to be undertaken. In order to get at a sequestrum in such a joint as the hip, for example, much of the neighbouring living bone may have to be removed in order to obtain free access to it.

It cannot be too strongly insisted upon, however, that the mere existence of one or more sinuses, even for a long period, in a case of tuberculous joint disease, does not by any means necessarily indicate the existence of necrosed bone. Prolonged antiseptic treatment of such sinuses frequently leads to their permanent healing without the evacuation of any necrosed bone. Prolonged and profuse suppuration, on the other hand, generally indicates the presence of dead bone.

Finally, when, in spite of all less radical means of treatment, the disease is found to be still steadily progressing, and the patient is becoming worn out by profuse suppuration and septic infection, amputation may have to be performed. The occurrence of amyloid disease, except in the case of the hip, generally demands this method of treatment.

Conclusions.

Tuberculous disease of bones and joints is generally a local disease. Nature herself does much to restrain and arrest the progress of the disease, especially if she be aided by keeping the affected parts at rest.

The surgeon's aim should be, as a rule, to help Nature to do her work by affording rest, and often by removing, by means of suitable and timely local operations, the products of tuberculous inflammation.

XX.

TUBERCULOSIS OF THE SPINE.

By ROBERT JONES,

F.R.C.S.E.,

Surgeon to the Royal Southern Hospital, to the Liverpool Country Hospital for Children, and to the Baschurch Hospital for Children; Consulting Surgeon to the Royal Alexandra Hospital, Rhyl; Lecturer on Clinical Surgery, Liverpool University.

One of the most important forms of tuberculous encroachment is that involving the spinal column. Deformity affecting the spine is largely associated with tuberculous disease; indeed, if we eliminated tubercle, we should reduce the number of deformities by 25 per cent. Spinal caries represents over 40 per cent. of tuberculous arthritis, and in respect of frequency is only equalled by hip disease. Hoffa computed from the Government statistics of Germany that there existed over half a million cripples in the country, and the census of England classes over 400,000 persons as deformed, of which nearly 100,000 are in London. Over 40 per cent. of all deformities occur below the age of ten, and 60 per cent. below the age of fifteen. When we realize that over 85 per cent. of these deformities are acquired, and only 15 per cent. congenital, it forcibly emphasizes the national importance of prophylaxis.

Young[1] analyzed 1,000 cases of diseases of the bones, with the following result:

Table indicating Relative Frequency of Tuberculous Disease.

Region.	Number of Cases.	Per Cent.
Vertebræ	416	41·6
Hip-joint	421	42·1
Knee	103	10·3
Ankle	33	3·3
Shoulder	2	0·2
Elbow	17	1·7
Wrist	8	0·8

Out of the above 1,000 cases, the mortality was 34, of which seventeen died under conservative treatment and seventeen following operation.

[1] Young, J. K.: "Orthopedic Surgery." Philadelphia, 1906.

Hrdlicka, who has specially studied tuberculous disease amongst the Indian tribes, gave Young valuable information regarding tuberculous disease. He examined large numbers of the skeletons of early Indians before their intercourse with the whites, and he failed to find any lesion suggestive of the affection. Amongst modern Indians tubercle is often met with in their bones, and very frequently in their lungs and glands. In the large cities of America and England tuberculosis of the spine is prevalent, but it is unknown practically in the pine-districts of Georgia, the desert regions of Arizona, and the forest sections of the Adirondacks.

Caries of the spine in children being at once the most fatal, the most prolonged, and the most common of tuberculous affections, it is imperative that early diagnosis and treatment should be adopted. It responds well if treatment be prompt, and carried out in suitable environment.

Ætiological Considerations.

Tubercle attacks the bodies of the vertebræ, very rarely the laminæ or spinous processes (Fig. 1). The factors are similar to those of tuberculosis generally, and depend on infection, predisposition, and the local condition which favours the development of the disease. Infection may take place directly through the blood-current by way of the respiratory or alimentary tracks, and predisposition may be hereditary or acquired. In 30 per cent. of cases the hereditary predisposition is positive, and results in a lessened resistance on the part of the patient; but this can be appreciably affected by regard to certain hygienic principles, such as the ingestion of wholesome food with plenty of fat, the appropriation of all the available sun-rays, and life passed in the open air. No child predisposed to tubercle should be allowed to live in proximity to a tuberculous patient, no matter in what part of the body the disease exists. Disease is more common in the towns than in the country, and amongst the poor than amongst the well-cared for. Local predisposition may be induced by injury. Injured cancellous tissue during the process of repair offers an inviting resting-place for the bacilli.

Tubercle in the spine is more frequent than tubercle of the joints. In an analysis made some years ago of his own cases, the writer found that of 1,450 cases of tubercle of joints, 833 occurred in the vertebræ, 547 in the hips, and the remainder were distributed in order of frequency between knee, ankle, elbow, wrist, and shoulders. It occurs almost equally in either sex. The disease may occur at any age, but it is more frequently found between the ages of two and nine. Forty-seven per cent. of the writer's cases occurred between the ages of three and six. The relative frequency of disease he found to be—cervical, 69; dorsal, 340; lumbar, 170.

Pathology.

Tuberculous changes take place in the spongy tissues of one or many vertebral bodies usually just below the fibro-periosteal layer of the anterior longitudinal ligament. The granulation tissue often advances, following the course of the vessels along the front of the spine, invading adjacent vertebral bodies. At times the process may

FIG. 1.—TUBERCULOSIS OF THE DORSAL VERTEBRÆ.

begin within the body of a vertebra, which may so extend as to form a cavity, which sooner or later collapses from superincumbent body-weight. It is to this defect in vertebral substance that we owe the characteristic angular projection associated with spondylitis. Separate foci of disease, though occasionally noted, are comparatively rare. Sometimes the disease creeps behind the longitudinal ligament, only superficially affecting the bodies, and is known as "spondylitis superficialis." Clinically, it runs a more rapid course, and is characterized

by rigidity without deformity. The tuberculous changes may extend backwards, involving the cord by pressure, or tuberculous collections may pass under the vertebral fascia into the surrounding structures. Repair takes place generally by ankylosis, which may be fibrous, cartilaginous, bony, or a combination of all.

Symptomatology.

The symptoms of spondylitis may be general or peculiar to the part affected. The facial expression is often indicative of fear, pain, and premature old age. The patient moves carefully, anxious to avoid a jar or sudden movement. Fatigue, irritability, uneasiness, disinclination for exercise, are usually observed; while often peripheral pains are felt in the terminal filaments of the nerves whose roots have suffered pressure.

The back must be carefully inspected. The most reliable sign in commencing disease is rigidity. It appears usually before pain, and always before deformity. Any portion which shows rigidity to *all* the normal movements is the subject of past or present arthritis. If, however, the rigidity is in one direction only, or even if movement is free in one direction, the diagnosis of spondylitis is very doubtful. It is upon this rigidity, which at first is due to muscular protective spasm, that the diagnosis must depend. It is only abolished in profound anæsthesia, and is present, but to a lessened extent, during sleeping. It is the first symptom to appear, and the last to disappear. We must carefully inspect for any deviation, excurvation, incurvation, or prominent vertebræ. All movements should be carefully tested. Tenderness to direct pressure over suspected areas will not be found. Textbooks are very misinforming on this point. When we recollect that the disease is in the anterior bodies of the vertebræ, it is difficult to imagine pain due to pressure over a spinous process.

Abscess.—Of 400 cases, abscess appeared in 44, which represents a proportion of 11 per cent. Abscess may develop in spite of the best treatment, but is more frequently found in the neglected case.

It is more often associated with disease occurring below the diaphragm, and is less frequently met with in the upper dorsal than in the cervical regions. It may make its way in any direction opening externally, or may traverse any open or closed cavities in juxtaposition, and in quite a number of cases the collection may become absorbed.

Paralysis may affect both lower extremities, and may come on early in the disease. It varies from mere muscular weakness to complete loss of function. The first symptoms are usually those of fatigue with a dragging of limbs. The reflexes are exaggerated;

unless the disease be in the lumbar region, the sensation is usually not impaired. Rigidity only sets in with secondary degeneration of the cord. Of 400 cases, 19 were complicated by paralysis, all of which recovered. The paralysis is generally due to a thickening of the membranes of the cord, to an invasion of tuberculous debris, and very rarely indeed to direct bony pressure. It may come on before the bony deformity or with the bony deformity, or late in the disease. It may bear no relation to the acuteness of the angle; it may disappear while the bony deformity goes on increasing, and it may exist without any kyphosis.

The special symptoms due to local conditions may be divided into

FIG. 2. — ATTITUDE IN TUBERCULOUS DISEASE OF UPPER CERVICAL REGION.

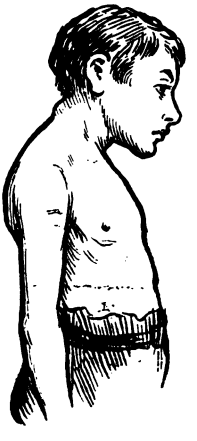

FIG. 3.—ATTITUDE IN DISEASE OF LOWER CERVICAL AND UPPER DORSAL REGION.

FIG. 4. — ATTITUDE IN TUBERCULOUS DISEASE OF UPPER DORSAL REGION.

three classes—viz., those connected with (*a*) cervical spondylitis, (*b*) dorsal spondylitis, (*c*) lumbar spondylitis.

Tuberculous Cervical Disease.

In cervical disease the first symptom is restriction of the normal range of movement. The body and head move in one piece. The eyes strain to follow you, but the vertebræ are not allowed to rotate. The neck is stiff. If any attempt be made to touch the head or to elevate the chin the child screams, but the head is held quite rigid. If the two or three upper vertebræ are diseased the head will be twisted to one side as in wry-neck, one or both mastoids being rigid (Fig. 2). If the disease is lower, the chin is advanced and dropped towards the chest, and an angular projection at the point of disease will be noted

(Fig. 3). If the disease be still lower, the chin is raised and the head is thrown back towards the raised shoulder (Fig. 4).

The posterior muscles may be so contracted that they may be mistaken for an abscess. Radiating pain of a neuralgic type following the course of the occipital and auricular nerves is present in a typical case. Young children may be very apprehensive of a stranger's approach, and in such a case the child may be placed across the parent's knees in the prone position. It will be noted that the head will not be allowed to dangle, however prolonged the examination,

FIG. 5.—FIXATION OF HEAD IN TUBERCULOSIS OF THE SPINE.

and in the supine position he will not carry it forward as in the first act of rising (Figs. 5 and 6).

The complications are abscess and paraplegia. Abscess points either at the back of the throat, or laterally, at the back of the sterno-mastoid; paraplegia is comparatively rare, and may affect both the upper and lower extremities.

Tuberculous Dorsal Spondylitis.

If the upper portion of the dorsal spine is affected, the attitude is one of forward inclination of the body; the shoulders are shrugged and square, and the head laterally deviated. If the lower part of the region is diseased, the body is erect, the gait cautious, and the body will not be bent forward.

Pain is frequently present, and is often mistaken for stomach-ache.

There is also a grunting respiration; a growing tendency to stand with the elbows resting on a chair or table; an inability to rise from a stooping position or pick an object from the floor without resting the hand on furniture or climbing up the limbs as in pseudo-hypertrophic paralysis (Fig. 7).

Timid children can be placed across the separated knees of the parent, and by elevating one knee rigidity of the spine may be noted without giving alarm. If the child is put on a table to sit, it will not move the body forward in the usual way. When deformity has taken place the diagnosis is easy.

FIG. 6.—POSITION OF HEAD IN TUBERCULOSIS OF SPINE WHEN PATIENT IS PLACED IN PRONE POSITION.

Paraplegia is more frequent in diseases of the upper dorsal spine than elsewhere. It begins with exaggeration of the tendon reflexes, with stumbling, and goes on usually to complete paraplegia.

Tuberculous Lumbar Spondylitis.

After rigidity one of the earliest signs is increased lordosis. It occurs as a compensation to the psoas contraction so often present. It is this deformity which leads to confusion between spondylitis and hip-disease. In the early stages the patient's shoulders are thrown back, one foot is slightly advanced, and the patient walks with care, holding his spine rigid. In the latter stages the lordosis disappears; the child bends his back forwards and walks with an obvious stoop from the pelvis.

Prognosis in Spondylitis of Tuberculous Origin.

Prognosis may be considered as to deformity and function, duration of life, and complications.

Deformity and Function.—In the cervical and dorso-lumbar regions the deformity may be reduced or eradicated if consolidation has not taken place. If consolidation has even commenced, increase in the deformity may be prevented. From the first to the sixth dorsal vertebræ the deformity will probably increase by any treatment short of uninterrupted recumbency; from the sixth to the tenth dorsal vertebræ an increase can generally be obviated. For deformity to be prevented in

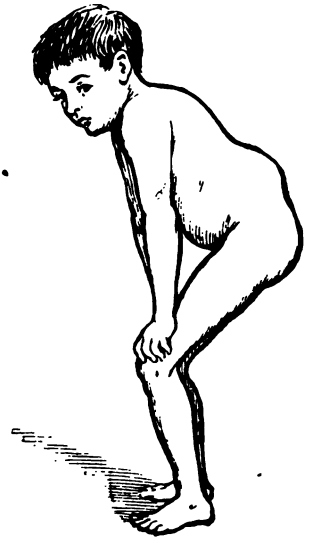

FIG. 7.—CHARACTERISTIC ATTITUDE IN TUBERCULOSIS OF THE SPINE.

the lumbo-sacral region recumbency in the hyper-extended position is essential.

Duration.—The average duration is from two to five years.

Life.—In cases under treatment the prognosis is about 8 per cent. of deaths. In untreated cases fully 30 per cent. die.

Complications.—Abscesses are reabsorbed in 40 per cent. of cases if recumbency and local rest be assured. Abscesses are best left alone, unless accompanied by signs of mixed infection. If evacuation be necessary the surgeon should wait until the skin reddens, when a small puncture will suffice. Abscesses that are incised early rarely heal by first intention, and often discharge for months and even years.

Paralysis.—Ninety per cent. of cases of complete paralysis recover if the patient be kept recumbent. The average duration of the paralysis

is six to eight months. In conjunction with Dr. John Ridlon, of Chicago, the writer has instanced cases where recovery has taken place after four years and one after six years.

Principles of Prophylaxis.

The preventive treatment of disease of the spine is the same as that of any other tuberculous affection. The bacilli which convey disease have a higher specific gravity than air, and cannot easily be propagated by simple respiration. Ashley[1] states that no current of air is capable of removing bacilli or spores from a moist surface, nor, he adds, can the disease often be spread by fæces or urine. It is clear, however, despite this, that infection may easily take place by an unguarded cough, so that it becomes essential to prevent children from having intercourse with tuberculous people. More especially should they be prevented from kissing folk whose moustache and beard render infection easy. It is undoubted, however, that sputum in its dry form, coming into contact with some surfaces, is the infective agent in the vast majority of cases. It follows, therefore, that not only should it be made sterile or destroyed, but that the mucous surfaces of children should be scrupulously attended to. As Ashley pointed out nearly twenty years ago, "of the working men and women in a factory, 10 per cent. more or less are consumptive. Their sputum is expectorated on floors and furniture, will get dry and pulverized, and inhaled." Thus the germ is carried over the community, infecting young and old. From the tailoring establishments, large and small, ready-made clothing shops, etc., the material to be worked up is given to the tens of thousands of men and women in whose dingy tenements tuberculosis, diphtheria, and other contagious diseases are indigenous. From this they infect the community. This frightful fact is sufficient to discourage the most hopeful philanthropist; it proves again the embarrassments and dangers of our social conditions, and the great difficulties our enlightened public hygiene will have to overcome. In view of the undoubted ingress of the bacilli from infected milk, its sterilization is imperative.

The amount of crippling in children with tuberculous spines can be modified materially by treatment. By an intelligent appreciation of the condition the gross deformities of tuberculosis of joints can be prevented in 80 per cent. of cases. Complete rest of the affected part, removal from infected surroundings, and life in the open air are the desiderata. Children's hospitals should be built in the country, not, as they often now are, in the very centre of our cities. We are just completing at

[1] Ashley, in Keating's "Encyclopædia of Diseases of Children," vol. ii., p. 182.

Heswall, on the banks of the Dee, a hospital, surrounded by ten acres of heather, for the active treatment of cases requiring prolonged care. We will possess ultimately 200 beds, and our tuberculous children will spend their whole day in the open. Hitherto the hospital has been situated in West Kirby, containing only twenty-five beds; but the results of our experience there has been convincing in regard to the therapeutic value of fresh air in the country. Our experience at the

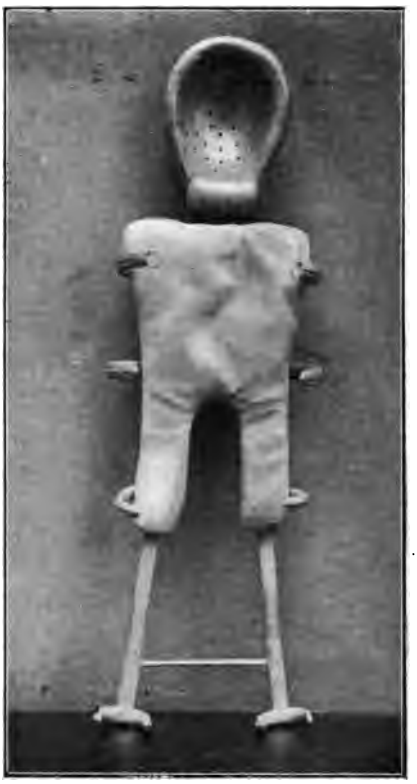

FIG. 8.—MODIFIED THOMAS SPLINT FOR TUBERCULOUS SPINAL DISEASE.

Baschurch Hospital has been equally encouraging. Here about forty-five children are kept day and night, in both winter and summer, in open wooden sheds in fields. From the operating theatre, immediately on their recovery from anæsthesia, they are taken into the open air. The result of such environment has been encouraging to a degree, and our prognosis in such cases is full of hope. When we look round our homes for incurables and our cripples' asylums in the bustle and noise of our cities, we see with regret a large proportion of spinal children,

with wan, pathetic faces, fighting a hopeless fight against well-meant but hostile surroundings. Let us recognize that sunshine and country air and good food are essential elements if full justice is to be meted to tuberculous children. Those of us who have spent our lives amongst these cases are often impressed by the qualities of brain and heart that many of them possess; qualities which, under better and more hygienic conditions, would prove valuable national assets.

General Principles of Treatment.

Treatment may be considered from a hygienic, therapeutic, mechanical, and operative standpoint.

FIG. 9.—THOMAS COLLAR APPLIED TO A CASE OF TUBERCULOUS DISEASE OF CERVICAL VERTEBRÆ.

Hygienic.—For many years the writer has refused to treat tuberculous cases in a town hospital ward for longer than has been needed to correct deformity by operative measures. Children belonging to the slums who can be kept lying outside their alley doors do better than when confined in a hospital ward under exemplary sanitary supervision. Good fresh air and sunshine are essential for tuberculous children, and should be secured for them at all costs. Wherever possible, they should be in the open air during the day, and in a tent at night-time. Having charge of hospitals in the middle of the country as well as in the town, the writer speaks with the authority of an exceptional experience when he pleads for open country air. If this cannot be secured, the room which the sun mostly favours should be

chosen, and the child should have the windows open night and day. Wholesome and easily digested food, with a good proportion of fat, should be prescribed.

Therapeutic.—This should consist in keeping the intestines regularly controlled, and in correcting errors of digestion. Cod-liver oil and iron are often beneficial.

A. E. Wright's investigations in determining the opsonic content of

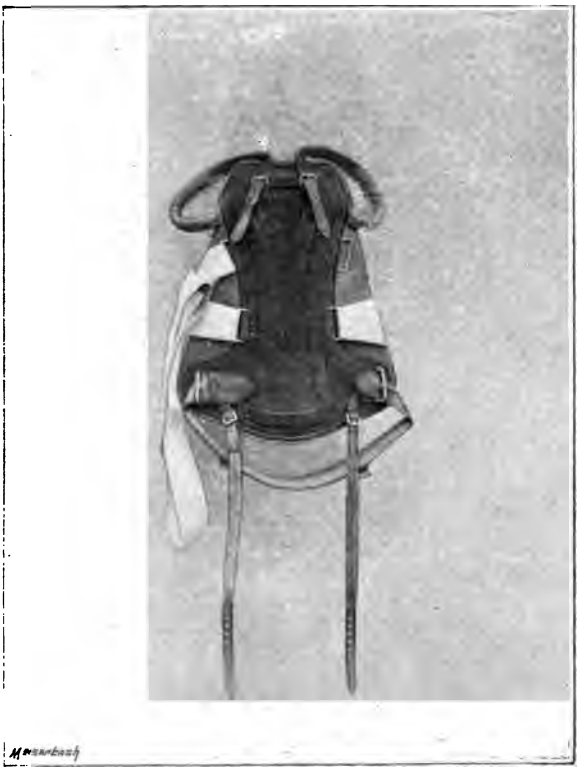

FIG. 10.—POSTERIOR SUPPORT FOR TUBERCULOUS DISEASE OF THE MID-DORSAL AND UPPER LUMBAR REGIONS.

the serum has revived interest in the subcutaneous introduction of tuberculin. There is no doubt that the new tuberculin contains marked curative properties. The harmful results have been due to excessive dosage. Doses for small children from $\frac{1}{4000}$ to $\frac{1}{1000}$ milligramme have proved distinctly helpful in many cases treated by the writer, and even where one cannot have an opportunity of estimating the index, no harm will follow the administration. The estimation of the

FIG. 11.—APPLIANCE FOR TUBERCULOUS DISEASE OF THE LOWER DORSAL AND UPPER LUMBAR REGIONS.

opsonic index is much too tedious and expensive to be of great practical service, and we must await developments in the direction of simplicity.

Mechanical.—Mechanical treatment aims at securing complete rest for the spine and the correction or prevention of deformity.

In the early stages of disease complete recumbency should form part of the mechanical device. The writer prefers to use a modified Thomas support, so bent as to keep the spine hyper-extended. This prevents the telescoping of the vertebral bodies, and consequently the formation of kyphosis. It should be carefully moulded, and can be carried about with the patient (Fig. 8) upon it as easily as a carpet-bag. Strips of boiler felt are placed above and below the prominence, so that during the prolonged reclination it is modified, or even fully corrected.

When twelve or eighteen months have passed, provided progress has been satisfactory, ambulatory treatment may be commenced. If the disease be in the cervical vertebræ, a Thomas collar may be applied (Fig. 9). Should the disease be in the lower cervical vertebræ, a posterior support (Figs. 10 and 11) should be added. This is a far more effective support than a plaster jacket, and allows of the complete expansion of the chest. If the disease is in the lumbo-sacral region, the splint will have to be worn considerably longer, as a short ambulatory recumbency splint will not supply sufficient leverage for support.

Space will not allow us to enter into the subject of the operative treatment of spondylitis. It includes the treatment of abscess and that of paraplegia. The abscess may be aspirated with or without antiseptic drainage. It may be incised, drained, and erased. The spinal column may be attacked, and necrosed bone removed. The writer has long since discarded the injection of emulsions into tuberculous cavities as useless when not harmful. Incision of an abscess is only needed when constitutional symptoms arise from mixed infection. Laminectomy for paraplegia is not so successful, and much more dangerous than forcible correction of deformity. It is an operation of gravity, and practically deprives the spinal column of its only support. When the operation is urged, surgeons should remember how rare it is to find a Pott's paralysis permanent.

XXI.

TUBERCULOUS CRIPPLES.

By A. H. TUBBY,

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Tuberculosis in infancy and childhood is accountable for much crippling and deformity. These handicapped lives are commonly met with, and arouse profound pity and regret. They bear the evidences of much individual suffering, and stand as witnesses of our national loss. And yet there are good reasons for believing that much of the crippling now only too manifest might, by the exercise of wise foresight, early care and greater supervision, have been prevented, or, at all events, much lessened.

The Frequency of Crippling from Tuberculosis.

The majority of crippled cases have been subjects of tuberculous disease of the bones and joints. It is difficult to give exact statistical expression to the amount of crippling due to this cause, but it is undoubtedly very great. I have dealt with this subject elsewhere, and shall here have mainly to recapitulate what I have already expressed.[1]

We may group our remarks about the three chief forms of cripples —spinal, hip, and knee-joint cases. It must, however, be remembered that more or less deformity may result from tuberculous involvement of any joint. In children the small joints of the hands and feet are not infrequently affected.

Cripples from Tuberculous Disease of the Spine.

It is extremely difficult to estimate the actual mortality, immediate and remote, due to tuberculosis of the spine. But it may safely be said, without fear of contradiction, that at least 20 per cent. of all patients die, either during the progress of the disease or within a few years of

[1] Tubby, A. H.: "Tuberculous Bone and Joint Disease in Children: its Effects on the Duration and Usefulness of Life," *British Journal of Tuberculosis*, July, 1907.

its onset. Even if the patient survives the acute stages of the disease and attains adult age, the span of life is appreciably shortened. The average age of adult spinal tuberculous cripples is considerably under fifty years of age, and contrasts very unfavourably with the expectation of life of healthy male adults. The disease is formidable enough in itself, apart from its most frequent complications, abscess and compression paraplegia. Deformity should not be regarded as an inevitable sequel of Pott's disease. If it is correct, as I have reason to believe to be the case, that not more than 5 per cent. of cases of spinal caries are diagnosed before deformity has set in, then what is required is a wider knowledge of the earlier symptoms and a more correct appreciation of the evil results of a hump-back. Among such are displacement of the heart and great vessels, and even in extreme cases kinking of the thoracic aorta. The lungs, too, are compressed and the blood insufficiently aerated. The result is gradual failure of the heart to carry on its work, and early death. If the formation of abscess complicates the case, as it is so likely to do in inefficiently treated patients, then the risk is immensely increased. It is found that 20 per cent. of cases of tuberculous spine are complicated by abscesses, and these constitute either an immediate danger to the patient's life, or render him entirely incapable of becoming a useful member of the community for a considerable period, even extending to years. Paralysis appears in 13 per cent. of the cases, and even when cured after long periods of recumbency is liable to relapse. Such figures speak for themselves.

Cripples from Tuberculous Disease of the Hip-joint.

Until recently a large number of cases of tuberculous hip were treated by operation, but now the results which can be obtained by conservative methods are believed to be more satisfactory. It was thought that in hospital patients, operation done comparatively early in the disease would limit the length of treatment, but the final results have not been on the whole such as to afford very great encouragement. It is true that the disease may be eradicated by early excision, but it must be conceded that in very many cases the usefulness of the limb is very largely impaired. The direct mortality of hip disease is undoubtedly due largely to the immediate or remote effects of abscess. The statistics obtained by Bruns clearly show this. The mortality of the non-suppurative cases was 23 per cent., as compared with 52 per cent. in suppurative cases. Statistics vary very largely, whether they are collected from the hospitals or from the results of private practice. According to Whitman, the death-rate in America has been estimated to be from 10 to 15 per cent. According to somewhat old returns of the Alexandra Hospital, a fatal issue followed in 26 per cent. of the cases. Whitman claims that the low rate in

America is accounted for by the facts that the patients are of a better class, and that they receive earlier and more efficient mechanical protection. The latter is a vital consideration. We must now turn to the functional results which can be obtained from the treatment of the disease. There is no doubt that in a small proportion of cases the joint may recover entirely, and this is dependent upon the extent of the disease, and the timeliness and efficiency of the treatment. The statistics obtained by Gibney, Waterman, and Reynolds of 107 cases in which mechanical and operative treatment was employed are very instructive. In more than half the number deformity was present when treatment was begun. No flexion was present at the end of the treatment in 47, but in 60 flexion followed of from ten to thirty degrees. Perfect movement was retained in 13, good in 22, limited in 41, and there was ankylosis in 31. In 69 cases the shortening was 1 inch or less, 35 having none. In 38 it was more than an inch. We therefore see that the disabling effects of hip-joint disease are very serious. But the lessons to be learned are that much crippling and danger can be saved to the patient if the case is recognized early and placed under skilled care, and has persistent treatment *from the beginning to the end of the illness.*

Cripples from Tuberculous Knee-joint Disease.

Gibney of New York has collected 300 cases. The mortality amounted to 40, or 13·3 per cent. Of those who survived, in 51 cases ankylosis was present; in 16 of these the limb was practically straight, and in 35 it was flexed more than thirty degrees. There is no doubt that when ankylosis of the knee exists in young life there is an increasing tendency towards deformity as the patient grows up. The results of operations upon the knee, such as arthrectomy and excision, are more satisfactory than in the case of the hip, but there is still much room for improvement.

Practical Considerations.

It appears to me that the whole question of the incidence of tuberculosis in childhood needs to be grappled with on systematic lines. The first point is that it must be thorough from beginning to end. A case once taken in hand should never be lost sight of, and should not cease to be under constant supervision, until it is cured or beyond the reach of cure. In dealing with tuberculosis, "half-cures are no cures at all." Early recognition, thorough and complete treatment, extending, it may be, over years, and watchful after-care, are the key-notes of success. There is no doubt that the question must be dealt with from a common-sense point of view. A careful record should be kept of every case seen, and each case followed up through all its

stages. This can only be done through the instrumentality of a central body having much influence and considerable funds.

These tuberculous cripples—at least, during the period when there is any activity of disease—should be cared for in the country.[1]

In this country and America, and on the Continent, there are many admirable hospitals where tuberculous cripples are dealt with,[2] but we are beginning to see that the best ends are not being attained by urban establishments, and that country sanatoria, training-schools, and working colonies must be established if we are to furnish these tuberculous cripples the fullest opportunity of overcoming their disease and compensating for their serious handicap.[3]

[1] Tubby, A. H.: "The Urban Hospital Treatment of External or Surgical Tuberculosis," *British Medical Journal*, February 21, 1903; also "Is the Urban Hospital Treatment of External or Surgical Tuberculosis Justifiable?" *The Practitioner*, September, 1903.

[2] See Annual Reports of the New York State Hospital for the Care of Crippled and Deformed Children (Hospital situated at West Haverstraw, Rockland County, N.Y.); also Minnesota State Hospital for Crippled Children.

[3] See First Annual Report of the Widener Memorial Industrial Training School for Crippled Children (North Broad Street and Olney Avenue, Philadelphia, Pa., U.S.A.).

XXII.

TUBERCULOSIS AMONG CHILDREN IN SCOTLAND.

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THE following is a presentation of certain facts, with some reflections, regarding the occurrence of tuberculosis in Scotland among children under fifteen years of age.

The Incidence and Prevalence of Tuberculosis in Early Life.

The clearest conception of the amount of tuberculosis prevailing in Scotland among children is obtained by a glance at the two accompanying tables (Tables I. and II.), which have been prepared with the kind co-operation of my friend Dr. J. C. Dunlop, Superintendent of Statistics in the Registrar-General's Office, Edinburgh. In perusing the tables it should be noted, in relation to the age distribution, which is the only one available, that deaths of children aged five years are grouped with those at ages *over* five, and not with those at ages *under* five. For the purposes of the tables, the populations had to be specially calculated. The populations used were based on the census figures of 1891 and 1901. It is assumed that between these years the population of Scotland increased in geometrical proportion, and that the increase continued until 1905. It is also assumed that the proportions which the numbers bore to the total population varied in arithmetical proportion. In every case the population was calculated to the middle of the year.

With regard to the second table, it should be noted that *tabes mesenterica* is detailed throughout as including tuberculous peritonitis. It must be kept in view further that the group of *tuberculous meningitis*, which does not include cases recorded as "meningitis" or "inflammation of brain," is probably somewhat smaller than it should be.

TABLE I.

DEATHS IN SCOTLAND OF CHILDREN AGED UNDER FIFTEEN YEARS FROM ALL TUBERCULOSIS AND FROM PHTHISIS, WITH THE EQUIVALENT DEATH-RATES PER 10,000 OF THE ESTIMATED POPULATION, 1891–1905.

YEAR.	DISEASE.	AGE.									
		Total under 15.		Under 1.		1 to 4.		5 to 9.		10 to 14.	
		Number.	Rate.	Number.	Rate.	Number.	Rate.	Number.	Rate.	Number.	Rate.
1891	All tuberculosis ..	3,271	22·8	758	70·3	1,254	31·7	637	13·3	622	13·7
	Phthisis	946	6·6	82	7·6	226	5·7	240	5·0	398	8·8
1892	All tuberculosis ..	2,912	20·2	630	58·1	1,150	28·9	607	12·7	525	11·6
	Phthisis	794	5·5	76	7·0	195	4·9	199	4·1	324	7·1
1893	All tuberculosis ..	3,266	22·6	836	76·5	1,284	32·1	570	11·8	576	12·6
	Phthisis	869	6·0	82	7·5	211	5·3	199	4·1	377	8·3
1894	All tuberculosis ..	2,838	19·5	665	60·5	1,091	27·1	515	10·7	567	12·4
	Phthisis	742	5·1	69	6·3	170	4·2	156	3·2	347	7·6
1895	All tuberculosis ..	3,374	23·1	832	75·2	1,360	33·6	603	12·5	579	12·6
	Phthisis	893	6·1	93	8·4	217	5·4	214	4·4	369	8·0
1891-1895	All tuberculosis ..	15,661	21·7	3,721	68·1	6,139	30·7	2,932	12·2	2,869	12·6
	Phthisis	4,244	5·9	402	7·4	1,019	5·1	1,008	4·2	1,815	8·0
1896	All tuberculosis ..	2,964	20·2	687	61·7	1,208	29·7	517	10·6	552	12·0
	Phthisis	737	5·0	70	6·3	169	4·2	168	3·5	330	7·2
1897	All tuberculosis ..	3,095	21·0	725	64·7	1,231	30·1	578	11·9	561	12·1
	Phthisis	781	5·3	73	6·5	179	4·4	178	3·7	351	7·6
1898	All tuberculosis ..	3,179	21·5	788	69·9	1,344	32·6	520	10·6	527	11·3
	Phthisis	720	4·9	78	6·9	189	4·6	145	3·0	308	6·6
1899	All tuberculosis ..	3,190	21·5	791	69·7	1,301	31·4	549	11·2	549	11·8
	Phthisis	699	4·7	57	5·0	179	4·3	157	3·2	306	6·6
1900	All tuberculosis ..	3,103	20·8	713	62·5	1,279	30·7	557	11·3	554	11·8
	Phthisis	759	5·1	70	6·1	195	4·7	171	3·5	323	6·9
1896-1900	All tuberculosis ..	15,531	21·0	3,704	65·7	6,363	30·9	2,721	11·1	2,743	11·8
	Phthisis	3,696	5·0	348	6·2	911	4·4	819	3·4	1,618	7·0
1901	All tuberculosis ..	3,108	20·8	739	64·3	1,285	30·7	553	11·2	531	11·3
	Phthisis	718	4·8	72	6·3	203	4·8	155	3·1	288	6·1
1902	All tuberculosis ..	2,863	19·1	588	50·9	1,195	28·4	544	11·0	536	11·4
	Phthisis	673	4·5	46	4·0	174	4·1	165	3·3	288	6·1
1903	All tuberculosis ..	3,022	20·0	687	59·1	1,234	29·1	597	12·0	504	10·7
	Phthisis	682	4·5	72	6·2	190	4·5	179	3·6	241	5·1
1904	All tuberculosis ..	3,328	22·0	700	59·8	1,374	32·2	647	13·0	607	12·8
	Phthisis	736	4·9	63	5·4	192	4·5	155	3·1	326	6·9
1905	All tuberculosis ..	3,115	20·5	658	55·9	1,309	30·5	601	12·1	547	11·5
	Phthisis	669	4·4	50	4·2	175	4·1	150	3·0	294	6·2
1901-1905	All tuberculosis ..	15,436	20·5	3,372	58·0	6,397	30·2	2,942	11·9	2,725	11·5
	Phthisis	3,478	4·6	303	5·2	934	4·4	804	3·2	1,437	6·1

TABLE II.

DEATHS IN SCOTLAND FROM TABES MESENTERICA (INCLUDING TUBERCULOUS PERITONITIS) AND TUBERCULOUS MENINGITIS AT AGES UNDER FIFTEEN YEARS, WITH THE EQUIVALENT DEATH-RATES PER 10,000 OF THE ESTIMATED POPULATION, 1891–1905.

YEAR.	DISEASE.	AGE.									
		Total under 15.		Under 1.		1 to 4.		5 to 9.		10 to 14.	
		Number.	Rate.	Number.	Rate.	Number.	Rate.	Number.	Rate.	Number.	Rate.
1891	Tabes mesenterica ..	755	5·3	208	19·3	347	8·8	122	2·6	78	1·7
	Tuberculous meningitis	1,180	8·2	385	35·7	535	13·5	185	3·9	75	1·7
1892	Tabes mesenterica ..	704	4·9	195	18·0	321	8·1	116	2·4	72	1·6
	Tuberculous meningitis	1,051	7·3	272	25·1	495	12·4	207	4·3	77	1·7
1893	Tabes mesenterica ..	848	5·9	261	23·9	395	9·9	122	2·5	70	1·5
	Tuberculous meningitis	1,111	7·7	366	33·5	503	12·6	177	3·7	65	1·4
1894	Tabes mesenterica ..	630	4·3	170	15·5	295	7·3	89	1·8	76	1·7
	Tuberculous meningitis	1,051	7·2	318	28·9	470	11·7	198	4·1	65	1·4
1895	Tabes mesenterica ..	840	5·8	244	22·1	419	10·4	111	2·3	66	1·4
	Tuberculous meningitis	1,188	8·1	366	33·1	545	13·5	206	4·3	71	1·5
1891-1895	Tabes mesenterica ..	3,777	5·2	1,078	19·7	1,777	8·9	560	3·2	362	1·6
	Tuberculous meningitis	5,581	7·7	1,707	31·3	2,548	12·7	973	4·0	353	1·5
1896	Tabes mesenterica ..	681	4·6	164	14·7	343	8·4	107	2·2	67	1·5
	Tuberculous meningitis	1,098	7·5	332	29·8	539	13·2	152	3·1	75	1·6
1897	Tabes mesenterica ..	740	5·0	237	21·2	335	8·2	108	2·2	60	1·3
	Tuberculous meningitis	1,142	7·8	314	28·0	557	13·6	202	4·1	69	1·5
1898	Tabes mesenterica ..	788	5·3	239	21·2	374	9·1	97	2·0	78	1·7
	Tuberculous meningitis	1,212	8·2	350	31·0	595	14·4	190	3·9	77	1·7
1899	Tabes mesenterica ..	816	5·5	250	22·0	369	8·9	127	2·6	70	1·5
	Tuberculous meningitis	1,197	8·1	367	32·4	568	13·7	183	3·7	79	1·7
1900	Tabes mesenterica ..	758	5·1	222	19·4	352	8·5	119	2·4	65	1·4
	Tuberculous meningitis	1,114	7·5	319	27·9	543	13·0	168	3·4	84	1·8
1896-1900	Tabes mesenterica ..	3,783	5·1	1,112	19·7	1,773	8·6	558	2·3	340	1·5
	Tuberculous meningitis	5,763	7·8	1,682	29·8	2,802	13·6	895	3·7	384	1·7
1901	Tabes mesenterica ..	880	5·9	254	22·1	435	10·4	107	2·2	84	1·8
	Tuberculous meningitis	1,030	6·9	315	27·4	469	11·2	171	3·5	75	1·6
1902	Tabes mesenterica ..	671	4·5	164	14·2	329	7·8	100	2·0	78	1·7
	Tuberculous meningitis	1,053	7·0	266	23·0	531	12·6	186	3·8	70	1·5
1903	Tabes mesenterica ..	749	5·0	205	17·6	341	8·0	137	2·8	66	1·4
	Tuberculous meningitis	1,045	6·9	288	24·8	499	11·8	181	3·7	77	1·6
1904	Tabes mesenterica ..	844	5·6	213	18·2	384	9·0	165	3·3	82	1·7
	Tuberculous meningitis	1,167	7·7	313	26·7	578	13·6	200	4·0	76	1·6
1905	Tabes mesenterica ..	821	5·4	193	16·4	384	9·0	165	3·3	79	1·7
	Tuberculous meningitis	1,077	7·1	306	26·0	548	12·8	157	3·1	66	1·4
1901-1905	Tabes mesenterica ..	3,965	5·3	1,029	17·7	1,873	8·8	674	2·7	389	1·6
	Tuberculous meningitis	5,372	7·1	1,488	25·6	2,625	12·4	895	3·6	364	1·5

The tables yield many points of extreme interest. In the foreground they show the vast amount of tuberculosis occurring among children. If we adopt the principle of multiplying mortality by ten to express the incidence of tuberculosis—and this for reasons considered elsewhere I feel sure is well within the mark[1]—the enormous part played by tuberculosis in relation to development and growth, and health and disease in childhood, becomes apparent. It must be recalled that, as already hinted, the tables err probably throughout in the direction of understating rather than overstating the mortality from different varieties of tuberculosis.

The total mortality in *all* children under fifteen from *all* tuberculosis is high, showing a mean for fifteen years of 21·1 per 10,000 of the population. During the entire period there has been a slight gradual fall of mortality from *all* tuberculosis from 21·7 per 10,000 (mean of period 1891-1895) to 20·5 per 10,000 (mean of period 1901-1905)—that is, a fall of 5·53 per cent.

During the same period the mortality from pulmonary tuberculosis (phthisis) in all children shows relatively a much more rapid fall—namely, from 5·9 per 10,000 (mean of period 1891-1895) to 4·6 per 10,000 (mean of period 1901-1905)—that is, a fall of 22 per cent.

If the several age periods be studied, it will be found that in each of the groups examined the mortality from pulmonary tuberculosis shows a remarkably greater percentage fall than that from *all* tuberculosis.

Thus, in the case of children under one year, while the mortality from *all* tuberculosis shows a fall from 68·1 per 10,000 (mean of period 1891-1895) to 58·0 per 10,000 (mean of period 1901-1905)—that is, a fall of 14·83 per cent.—the mortality from pulmonary tuberculosis shows a fall from 7·4 per 10,000 (1891-1895) to 5·2 per 10,000 (1901-1905)—that is, a fall of 29·73 per cent.

In children from one to four years, while the mortality from *all* tuberculosis shows a very slight fall from 30·7 per 10,000 (1891-1895) to 30·2 (1901-1905)—that is, a fall of 1·63 per cent.—the mortality from pulmonary tuberculosis shows a fall from 5·1 per 10,000 (1891-1895) to 4·4 (1901-1905)—that is, a fall of 13·73 per cent.

In children of five to nine years of age, while the mortality from *all* tuberculosis shows a fall from 12·2 per 10,000 (1891-1895) to 11·9 (1901-1905)—that is, a fall of 2·46 per cent.—the mortality from pulmonary tuberculosis shows a fall from 4·2 per 10,000 (1891-1895) to 3·2 (1901-1905)—that is, a fall of 23·80 per cent.

Similarly, in children from ten to fourteen years of age, while the mortality from *all* tuberculosis shows a fall from 12·6 per 10,000

[1] Philip, R. W.: "Public Aspects of the Prevention of Tuberculosis," *British Medical Journal*, December, 1906.

(1891-1895) to 11·5 (1901-1905)—that is, a fall of 8·73 per cent.—the mortality from pulmonary tuberculosis shows a fall from 8·0 (1891-1895) to 6·1 (1901-1905)—that is, a fall of 23·75 per cent.

The figures show, further, that the apparent fall in mortality from *all* tuberculosis is really referable in largest part to the decrease in mortality from pulmonary tuberculosis. If we subtract pulmonary tuberculosis from *all* tuberculosis, it will be found that the total mortality in all children under fifteen from tuberculosis *other than phthisis* actually shows a *rise* of 0·63 per cent. during the entire period.

The following table, showing death-rates of tuberculosis *other than phthisis* per 10,000 of the population for the several age periods, emphasizes the significance of the fall in the phthisis rate as the chief element in the apparent decrease of mortality from *all* tuberculosis. It is especially worthy of remark that, while there is a decided fall for the age period under one year, and only a slight rise for the period from one to four years, there is a pronounced rise from five to nine years amounting to 8·75 per cent., and a still greater rise between ten and fourteen years, amounting to 17·39 per cent. I shall have something further to say about this presently.

TABLE III.

DEATHS IN SCOTLAND FROM TUBERCULOSIS OTHER THAN PHTHISIS AT AGES UNDER FIFTEEN PER 10,000 OF THE ESTIMATED POPULATION IN SCOTLAND, 1891-1905.

Year.	Total Children.	Under 1 year.	1 to 4 years.	5 to 9 years.	10 to 14 years.
1891-1895	15·8	60·7	25·6	8·0	4·6
1896-1900	16·0	59·5	26·5	7·7	4·8
1901-1905	15·9	52·8	25·8	8·7	5·4
	Increase, 0·63 %	Decrease, 13·01 %	Increase, 0·78 %	Increase, 8·75 %	Increase, 17·39 %

If we return to Table II., and make a similar analysis to that already done in relation to Table I., several facts of much significance emerge.

Thus, in the foreground, the mortality of *all* children from *tabes mesenterica* during the period (1891-1905) actually shows a *rise* of 1·92 per cent., while contrariwise the mortality of *all* children from tuberculous meningitis shows for the like period of time a *fall* of 7·79 per cent.

With regard to *tabes mesenterica*, it is of much interest to note that the *increase* of mortality is most conspicuous for the age period from five to nine, while in children under one year and from one to four

years—that is, the time when milk-feeding plays a more important part—a slight *decrease* in mortality is traceable throughout the fifteen years (1891-1905). This is all the more noteworthy as there seems reason for the admission that in Edinburgh, during recent years, there has been a definite increase in the extent to which infants are reared artificially.

Turning once more to the death-rate from pulmonary tuberculosis *for the several age periods*, some striking points present themselves.

In the first place, the frequency of pulmonary tuberculosis in children under one year is shown to be higher than is sometimes supposed. In *each* of the three quinquennial periods from 1891 to 1905, the mortality of children under one year is greater than the mean mortality of all children under fifteen. This is the more remarkable when it is kept in view that in the Registrar-General's statistics a separate column exists for general tuberculosis. The tendency to place a case of pulmonary tuberculosis, as it occurs in an infant, in the category of general tuberculosis must be greater than at later ages, when discrimination between the organs affected is necessarily easier.

Further, while there is a remarkable *decrease* in the rate as between children under one year and children under five, in each of the three quinquennial periods—namely, (1891-1895) 2·3 per 10,000, *i.e.* 31·08 per cent.; (1896-1900) 1·8, *i e.* 29·03 per cent.; and (1901-1905) 0·8, *i.e.* 15·38 per cent., and likewise a *decrease* in the case of children from five to nine years—namely, (1891-1895) 0·9, *i.e.* 17·65 per cent.—there is contrariwise a most striking *increase* in the rate when we pass to the next group, from ten to fourteen years of age. The increase amounts in the first period (1891-1895) to 3·8, *i.e.* 90·48 per cent.; in the second (1896-1900) to 3·6, *i.e.* 105·88 per cent.; and in the third (1901-1905) to 2·9, *i.e.* 90·63 per cent.

Tuberculosis among School-Children.

This analysis of the statistics might be extended considerably. A number of points occur to me as I write. For the present, however, I content myself with the foregoing. Incidentally a number of reflections have suggested themselves, and one or two of these I desire to emphasize.

The most remarkable, truly astounding, fact which seems fairly deducible is the part which the *school-life* of the child seems to play in increasing liability to, and mortality from, tuberculosis. This is evidenced especially by what I have stated regarding the extraordinary *rise* in the death-rate from pulmonary tuberculosis when we pass from the group five to nine years of age to the group ten to fourteen years of age. It is a fact of which I had no true conception until I undertook the analysis of the statistics on the present occasion.

The grave significance of school-life seems further borne out by the facts to which I have referred in relation to the mortality rates from tuberculosis *other than phthisis* (see Table III.). These go to show that, while for *all* children during the period (1891-1905) there has been a slight *increase* amounting to 0·63 per cent., there has been *under one year* a marked *decrease* in mortality, followed by a slight *increase* in mortality for the age period *from one to four years*, and a very decided *increase* for the age period *from five to nine years*, amounting to 8·75 per cent., and a still greater *increase* for the age period *from ten to fourteen years*, amounting to 17·39 per cent.

This would seem to suggest that improvement in the conditions of school-life has not advanced *pari passu* with other sanitary progress during the period under review (1891-1905). The facts seem to constitute a grave indictment against ordinary school-life, and urgently call for serious consideration.

Prophylactic and Therapeutic Measures.

So much for the extent of the problem as regards tuberculosis among children in Scotland. There remains space only to add a word or two regarding the means at present available to combat it.

It must be admitted that the provision for the treatment of tuberculosis in children in Scotland has been far too scanty. Indeed, there has been very little *special* provision at all. In several of the larger centres, including Edinburgh, Glasgow, and Aberdeen, hospitals exist for the treatment of sick children. The number of beds available is approximately 280. In addition to this, a good many tuberculous patients find their way from time to time into the general hospitals.

Special provision for the prevention and treatment of tuberculosis is to be found so far chiefly in Edinburgh. There, both at the Royal Victoria Dispensary and the Royal Victoria Hospital, a considerable proportion of children are received for treatment. The School Board authorities co-operate in pleasant fashion with the hospital authorities in the matter. In the domiciliary visits paid by the assistant physician, the nurse, and ladies of the Samaritan Committee in connection with the Victoria Dispensary, particular attention is paid to the children of the household, so that the unaffected may be separated from the affected as much as possible; and affected children may be prevented from attending school, and have their education, so far as can be arranged, conducted on more physiological lines. Up to the present, there has not been established in Scotland a hospital devoted to tuberculous children.

Special Schools for Tuberculous Children.

For many years it has been my endeavour to arouse public attention to the need for special schools for the training of tuberculous children—schools where education in the commonly accepted sense would take a second place, and consideration be given primarily to the physical reformation of the child. A tuberculous child ought not on account of delicacy to be kept at home. He should be sent to a school run on physiological lines, presided over by teachers whose chief aim would be to assist in the development of the delicate frame. The whole conception of school-life, so far as these children are concerned, wants remodelling. Much of the school work should be done in the playground, or, better still, in a large park, rather than in the class-room. In all our large centres one or more such open-air schools should exist, and School Boards should insist that tuberculous children be sent there.

Beyond all this, there is a pressing duty incumbent on School Boards to reform the ordinary class-room, and to demand much freer natural ventilation. The child should from the first be taught the need of the open window, not only during intervals, but especially when the class work is in progress. Every public school ought to have large playgrounds. This is of greater moment than are the palatial buildings at present being erected by many School Boards. Lastly, no child or teacher affected with tuberculosis ought to be allowed to continue attendance at the school.

The facts which I have cited in relation to the mortality from tuberculosis during the period of school-life afford complete warrant for a rigorous medical inspection with regard to all these points.

XXIII.

TUBERCULOSIS AMONG CHILDREN IN IRELAND.

By Sir JOHN BYERS,

M.A., M.D., M.CH., M.A.O. (HON. CAUSÂ),

Professor of Midwifery, Queen's College, Belfast; Examiner in Midwifery, and in Diseases of Women and Children, to the Royal University of Ireland; Physician to the Maternity Hospital, Belfast; Physician for Diseases of Women to the Royal Victoria Hospital; Consulting Physician to the Belfast Hospital for Sick Children; and Member of the Executive Committee for Great Britain and Ireland of the International Congress on Tuberculosis, Washington, 1908.

That the condition of Ireland as regards tuberculosis is most deplorable is evident from the following facts:

1. In the records of the various countries of the world, Ireland stands fourth highest for its mortality from tuberculosis, being only exceeded by Hungary, Austria, and Servia.

2. Comparing England, Scotland, and Ireland, it appears that while in 1864 Ireland stood lowest of the three, with a death-rate of 2·4 per 1,000 from all forms of tuberculous disease, the rate in England being 3·3, and that for Scotland 3·6, in 1905 Ireland was highest with a rate of 2·7, Scotland next with 2·1, and England lowest with a rate of 1·6. In 1906 the rate was still 2·7 in Ireland. Another point of terrible significance is that in 1907 (as stated recently by the Irish Registrar-General) the mortality for consumption was—putting aside Dublin and Belfast—in the other twenty principal towns and districts of Ireland, actually higher than in 1906. Further, one of the most noteworthy facts associated with the tuberculosis problem in Ireland was the curious feature that, while the death-rate in England, Scotland, Germany, and America, among women from pulmonary tuberculosis had steadily fallen until it was distinctly less than among men, in 1906, in Ireland, more women than men died of pulmonary tuberculosis. Comparing Belfast with Manchester, there is in Belfast a marked excess of mortality from pulmonary tuberculosis among *females* over that among males at practically all ages between five and thirty-five, while in Manchester there is a marked excess among *males* at all ages,

except those under twenty. This high female consumption mortality is, in my opinion, due in Ireland to the fact that, by the working of the Poor Law system, the poor largely receive out-door relief in the form of medicine and medical treatment through the dispensary doctors in their own homes. As a result, the advanced open dangerous cases of pulmonary tuberculosis are treated in their own homes, and the women (mothers, wives, sisters, and daughters) nursing them become themselves infected. In a country like Ireland, largely agricultural and with few industries, the high mortality among women from pulmonary tuberculosis indicates domestic and not industrial infection.

3. In Ireland, in 1906, out of a total of 74,427 registered deaths, 11,756, or 15·8 per cent., were due to various forms of tuberculosis, as follows:

Tuberculous phthisis (phthisis)	8,933
Tuberculous meningitis	797
Tuberculous peritonitis	299
Tabes mesenterica	167
Lupus	12
Tuberculous diseases of other organs ...	633
Tuberculosis, or General tuberculosis ...	858
Scrofula	57
Total	11,756

The Incidence of Tuberculosis among Children.

Now, on analyzing these figures with regard to age, in order to see how children are affected, we find that of the 8,933 deaths from tuberculous phthisis (phthisis), by far the greater number of deaths (2,573) occurred in the age period between twenty-five and thirty-five years. Up to five years there were 152 deaths, and from five to ten years 140 deaths, and from ten to fifteen years 367 deaths—facts which show that phthisis is least common in children. Of tuberculous meningitis, out of 797 deaths, 386 occurred under the age of five years, 178 between five and ten years, and 90 between ten and fifteen years. Of tuberculous peritonitis (deaths 299), 89 deaths occurred under five years, and 85 under fifteen years. Of tabes mesenterica (167 deaths), 115 deaths were under five years, and 25 under ten years. No death from lupus occurred among children. Out of 633 deaths from tuberculous diseases of other organs, 79 deaths were under five years of age. Of the 858 deaths from general tuberculosis, 309 were among children under five years of age, and 88 deaths occurred between the age period of five to ten years. Lastly, of the 57 deaths from scrofula, 15 were under five years of age, and 6 between five and ten years.

Of the various forms of tuberculosis, children in Ireland have the greatest mortality from tuberculous meningitis, tuberculous peritonitis,

tabes mesenterica, and general tuberculosis, or, as it is often registered, tuberculosis.

Another curious point is that, while in Ireland the highest death-rate from all tuberculous diseases occurs at the age period fifteen to forty-five years, in England and Scotland the highest death-rate from all tuberculous diseases appears in the population under five years of age. We must with this take the infantile mortality of Ireland, which is low—95 per every 1,000 babies born; but when we divide Ireland into urban and rural districts, we find in the latter, while the infantile mortality is 79·2, it is 144 in the towns (in England and Wales in 1906 the infantile mortality was 133 per 1,000; being 146 in large towns, 138 in smaller towns, and 115 in the area outside the towns); while in 1907 the rate of infantile mortality in England and Wales did not exceed 118 per 1,000 births registered, which is the lowest rate on record since the announcement of civil registration in 1837. In the borough of Huddersfield, in 1907, the infantile mortality rate sank to 97 per 1,000. In Dublin, in 1906, it was 146, and in Belfast 144. It is the small rural mortality in infants under one year—due largely to breast-feeding—which not only keeps the general infantile death-rate in Ireland so low, but which probably explains the fact that at an early period of life tuberculosis does not account for such a number of deaths in Ireland as it does in England and Scotland.

In a recent paper, M'Caw[1] points out that in the two children's hospitals in Belfast, close on 30 per cent. of the intern patients suffer from tuberculosis in some form, and the following interesting table (collected by Dr. M'Caw) shows a remarkable agreement among various children's hospitals on this point:

TABLE INDICATING THE RELATIVE FREQUENCY OF TUBERCULOUS CASES IN DIFFERENT CHILDREN'S HOSPITALS.

	Number of Intern Patients.	Number Tuberculous (per Cent.).
1906—Belfast Hospital for Sick Children ...	827	26·10
1906—Ulster Hospital for Children, Belfast ...	247	30·36
1905—Great Ormond Street Hospital, London...	2,876	27·00
1906—Royal Edinburgh Hospital	1,968	20·00
1905—Manchester Children's Hospital	1,999	21·30
1905—East London „ „	2,054	24·30
1906—Glasgow „ „	1,177	27·95

[1] M'Caw, J.: *British Medical Journal*, December 21, 1907.

A large proportion of the cases in the Belfast Children's Hospitals (about 40 per cent.) were surgical—that is, spinal caries, chronic abscesses, joint affections, lymph-adenitis, lupus, and bone disease. Now, the preponderance of surgical tuberculosis in children, and the comparative rarity of pulmonary phthisis, coupled with the recently published conclusions of the Royal Commission on Tuberculosis, and the fact that in Ireland at least 30 per cent. of the cows are tuberculous, arouse the suspicion that the view of Von Behring is probably correct, and that, in the case of children, tuberculosis is largely due to the consumption of tuberculous milk of bovine origin. Indeed, in the view of many, tuberculosis in the adult may turn out to be simply the outburst, under suitable conditions (lowered vitality), of a tuberculosis introduced into the body by the milk consumed in infancy.

While in Ireland, as I have pointed out, by far the greater number of deaths from "tuberculous phthisis" occurred in the age period twenty-five to thirty-five years, it is most interesting to note that, although from up to five years there were, in 1906, 152 deaths from this cause, and from five to ten years 140 deaths, the deaths rose to 367 between ten and fifteen years. Has school-life anything to do with these figures? I can only say that the state of the primary schools in Ireland, from a hygienic point of view, is anything but satisfactory, as is apparent to one reading the Report of the Commissioners of National Education in Ireland for the school year 1905-1906. After giving some terrible illustrations, the Commissioners in this volume say: "While overcrowding is the chief defect in the centres of population, many of the school-houses in rural districts are mere hovels. Uneven earthen floors, broken roofs through which the rain freely enters, windows incapable of admitting sufficient light or air, are common defects. Even in schools that afford sufficient accommodation, and that are not defective on sanitary grounds, improvements are required to provide proper class teaching." A deputation of members of the National Board of Education visited Belfast recently for the purpose of inspecting a number of the National schools in that city which are regarded as unsatisfactory in the matter of accommodation or otherwise, and also of conferring with local managers with a view to the introduction of improved school conditions.

Prevention and Treatment of Tuberculosis in Children.

There can be no question that, in reference to the prevention and treatment of tuberculosis, Ireland in the past has been terribly behind other nations; but, thanks to the Women's National Health Association of Ireland, established in March, 1907, by Her Excellency the Countess of Aberdeen, the people are at last becoming thoroughly educated as to its preventability and the feasibility of arresting the progress of the

disease, especially in its early stages. This splendid organization (and it owes all its success to the strong personality and ceaseless exertions of the Countess of Aberdeen) has as its main object to arouse public opinion, and especially that of the women of Ireland, to a sense of their responsibility regarding the public health, and to spread the knowledge of what may be done in every home and by every householder to guard against disease, and to promote the upbringing of a healthy and vigorous race.

The questions specially to be dealt with are tuberculosis, infantile mortality, the milk-supply, and school hygiene. Taking tuberculosis as the most pressing problem, a Tuberculosis Exhibition was inaugurated in Dublin in October, 1907, and was held in the grounds of the great International Exhibition at Ball's Bridge. At this exhibition there was a thorough objective presentation of everything bearing on the history, distribution, causation, prevention, and cure of tuberculosis; admirable lectures were delivered,[1] literature was freely distributed, demonstrations of the exhibits were made; and, in a word, the exhibition was utilized as a great educational measure in teaching the people what could be done to avert what has been well called by Oliver Wendell Holmes the "white plague" of Ireland. The exhibition has since visited various other cities and towns in Ireland, and has attracted immense audiences (in Belfast 43,000 people attended it during twelve days), and has led to a great awakening among the people. So pressing has been the demand for this Tuberculosis Exhibition that it has been necessary to duplicate it, and one of these exhibitions has been visiting various towns in the North of Ireland, while the other has kept to the southern parts of the country. Wherever these exhibitions have gone, crowds have visited them, and have also attended the lectures. It is interesting to record that through the kindness of Her Excellency the Countess of Aberdeen, President of the Women's National Health Association of Ireland, Mr. Robert Brown, hon. secretary of the Ulster branch of the National Association for the Prevention of Tuberculosis, has been able to arrange that in the Irish Village at the Franco-British Exhibition in London there is a Tuberculosis Exhibition, and that the profits of this Irish Village are to be devoted to the furtherance of the campaign against tuberculosis, now being waged in Ireland. Now, keeping in mind what has been stated in reference to the incidence and mortality among children from tuberculosis, and that we are only now beginning to face the tuberculosis problem in Ireland, I would recommend for the prevention and cure of tuberculosis among children in Ireland—

1. The encouragement of breast-feeding among the women living

[1] See "Ireland's Crusade against Tuberculosis," being a series of lectures delivered at the Tuberculosis Exhibition, 1897, under the auspices of the Women's National Health Association of Ireland, edited by the Countess of Aberdeen, vols. i and ii. Dublin, Maunsel and Co., Ltd., 96, Middle Abbey Street. 1908.

in the towns as well as among any of those residing in the country districts who do not do so, provided the mothers are themselves not suffering from tuberculosis. Such a method is by far the best one, and it avoids the risk of giving tuberculous milk at an early period of life.

2. The notification of all births within thirty-six hours, so as to get a knowledge of the environment of the children, and to combat the prevailing ignorance of how to live. In Belfast (the only town in Ireland which has up to the present adopted the Notification of Births Bill) the Infantile Mortality Committee of the Belfast Branch of the Women's National Health Association have—in addition to providing lady visitors, as in the Huddersfield scheme—established in one of the most populous districts of the city what is styled a "Babies' Club," where infants under a year old are brought by their mothers. These babies are weighed (a careful record is kept), the mothers are instructed as to the correct way of feeding and bringing up their children, as to the best clothing of their infants, and proper outfits for expectant mothers are supplied at cost price. The experiment has been a great success, and it is also noteworthy that those visiting the mothers and infants at their homes have frequently an opportunity of hearing of the existence of cases of consumption in these homes, which they report to their Tuberculosis Committee. The Medical Officer of Belfast sends the notifications of births to the honorary secretary of the Belfast branch of the Women's National Health Association.

3. Complete control on the part of the State, and of the various urban and rural authorities, of the milk-supply. Modern clean dairying, under strict veterinary and medical inspection, and the elimination of cows infected by tubercle should be obligatory, and dairies in the centre of large, densely populated towns should be removed. The various agricultural shows should not give prizes to owners of cattle who will not—at their time of entry—submit a certificate to indicate that they have not reacted to the tuberculin test.

During the past year the Local Government Board of Ireland has issued a new General Order "with respect to dairies, cowsheds, and milk-shops," which has placed increased powers in the hands of County, Borough, Urban, and Rural District Councils. This came into operation on May 1, and we trust that these authorities will see that Article 23 of this order is carried out: "It shall not be lawful for any person following the trade of cow-keeper or dairyman to occupy as a dairy or cowshed any building, whether so occupied at the commencement of this order or not, if and as long as the lighting and the ventilation, including air-space, and the cleansing, drainage, and water-supply thereof are not such as are necessary or proper—

"(*a*) For the health and good condition of the cattle therein; and

"(*b*) For the cleanliness of milk-vessels used therein for containing milk for sale; and

"(*c*) For the protection of the milk therein against infection and contamination."

It has been arranged that the "Babies' Club" in Belfast shall be supplied solely with pure milk sent in bottles from a dairy where all tuberculous cows have been eliminated, and in this way an object-lesson is given in getting rid of one of the principal causes (tuberculous milk) of consumption, and in showing how a pure milk can be provided which needs no subsequent pasteurizing or sterilization.

4. There should be proper management of the hygiene of the primary schools as to ventilation, overcrowding, and sanitary arrangements. Medical inspection, both of the school premises and of the children, should be compulsory, and the children should be taught the principles of hygiene and temperance, and ample time should be allowed for the children to go home for dinner. In Belfast the School Hygiene Committee of the local branch of the Women's National Health Association have, in connection with one of the large primary schools, adopted a plan found useful in Germany—that is, the ladies of this committee try to get into touch with the children after school hours, and especially in the case of those whose parents are working, say, up to six o'clock in the evening, so as to give them hints as to personal and domestic hygiene. Each child so remaining receives a glass of milk and a piece of bread.

5. The dwelling-houses in both urban and rural districts should be made more sanitary. The people must be educated as to the importance of keeping their houses clean and sanitary, well ventilated, not overcrowded, and, if possible, so situated as to be exposed to the rays of the sun.

6. Children should get nutritious, properly cooked food.

7. All advanced cases of phthisis should, in the interest of the healthy members of the community, be segregated and treated in institutions, and not in their homes (a practice followed in Ireland to a far greater extent than in either Scotland or England), where the other dwellers there, including the children, may be infected by them.

8. As there is great truth in the remark made by Holt—"If fresh air and a proper climate are necessary for the cure of this disease in adults, they are tenfold more necessary in the case of children. . . . Nowhere do these cases do so badly as in a hospital located in a city, and no class of tubercular cases do worse than these"—it would be infinitely better if all cases of tuberculosis in children were, at least in the case of our cities, segregated in special hospitals in the country or by the sea-side. In connection with the Convalescent Home of the Royal Victoria Hospital, Belfast, there is a children's department (founded by the late Mr. E. Martin) for diseases of the spine and hip. It is the feeling of many that an arrangement might be made by which

all the tuberculous cases now treated in the two children's hospitals in Belfast might be removed to this convalescent hospital, where—owing to its being situated in the country—such patients would do much better. In connection with the Cripples' Institutes in Belfast, there is also an excellent convalescent home at Bangor, a resort on the east shore of Belfast Lough.

9. In order to get at the cases, and to see what stage they are in, all types of tuberculosis should be made compulsorily notifiable.

10. Everything that tends to educate the people of Ireland as to the dangers of tuberculosis, such as lectures, leaflets, exhibitions, etc., is to be encouraged; and I believe visits among the poor, in order to instruct them as to what is now known in regard to the disease (especially as to cleanliness, sleeping in a room by themselves, and the treatment of the expectoration), by the members of the various branches of the Women's National Health Association of Ireland, or by specially trained nurses supplied—where funds permit—by these branches, will be of enormous aid. In the larger towns the institution of a dispensary for tuberculous patients would be of the greatest value.

In Ireland we are only at the beginning of the anti-tuberculosis campaign, but, thanks to the formation of the Women's National Health Association, there is a great public awakening, and we have made immense progress during the past year in the education of the people. We trust that in the efforts that will be put forth to stamp out the disease equal attention will be paid to children as to adults.

XXIV.

TUBERCULOSIS AMONG CHILDREN IN FRANCE.[1]

By Professor A. CALMETTE,
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AND

M. BRETON,
M.D.,
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Since Dr. Armaingaud, twenty years ago, founded the first French League against Tuberculosis, there has been a great increase in the number and activity of movements aiming at the protection of children from tuberculous disease in France. Indeed, under the inspiration of such leaders in hygienic reform as Professors Brouardel, Grancher, and Landouzy, and with the moral support of such eminent politicians as Messrs. Casimir-Perier, Loubet, and Bourgeois, these public efforts and associated enterprises have prospered highly and accomplished much. Their beneficent character has been readily understood by the French nation, which has realized that by their work the best weapons against tuberculosis have been provided. Their social value also has been appreciated by our public administrative bodies, which have lent them their practical support.

It is to private philanthropic enterprise that France is indebted for the first efforts in the campaign against tuberculosis; but it is only just to recognize the part which the Government has taken in the campaign by making and enforcing laws calculated to improve public health.

The measures taken for the prevention and cure of infantile tuberculosis aim at (*a*) the destruction of the bacillus, so drying up, as it

[1] We are indebted to Dr. Charles Gaskell Higginson for the English translation of the valuable article by Professor Calmette and Dr. Breton.—Editor.

were, the very source of infection; (*b*) at strengthening the power of resistance which the organism can exert against tuberculous invasion. There can be no effectual destruction of the bacillus, unless we know the various ways in which the disease is contracted. This knowledge need no longer be considered Utopian. Our knowledge of the ætiology of tuberculosis has made great strides during these last few years. We fear such microbes as the wind wafts with the dust far less than such contaminated materials as are repeatedly touched and ingested. Professor Landouzy's report to the Vienna Congress of 1907 shows how many forward steps have been taken in our knowledge of causal factors since the days of Chauveau's classical work. It seems that to the old controversial question, as to whether a parasite can be, through the act of conception, inherited by a child from its parents, a negative answer must be returned. Certainly, a tissue-character may be inherited, which we may call dystrophic, or even describe as *para-tuberculous;* but the appropriate soil, so to speak, needs to be prepared before the tuberculous seed can take root and germinate.

Various associations and leagues have been formed in France, and constitute the machinery of the campaign against tuberculosis. All of them recognize the need of acting in accordance with the late Professor Grancher's happy expression, "*sauver la graine.*" The movements seeking the prevention and arrest of tuberculosis may be considered separately.

Protection of the Mother.

The *Mothers' Help Societies* (*œuvres maternelles*) aim at financially assisting the future mother when near her confinement, so enabling her to leave her work during the last month of pregnancy. They also seek to secure for the pregnant woman physical rest and moral support, by facilitating her admission to public dormitories and day-rooms, suitable workrooms, places of refuge, and maternity hospitals (*des chauffoirs, des asiles-ouvroirs, asiles-refuges et maternités secrètes*), where she can receive such care as her condition demands. Indeed, some "Leagues for Helping the Mother" (not yet, we admit, fully formed) propose to keep the mothers of newly-born infants in hospital for some weeks after delivery, and to put out under official care such children as may be left at home. The aim of these several leagues is one of purely general beneficence, and makes no pretence of directly combating tuberculosis.

Protection of Early Infancy.

Under this heading we may include crèches and milk dispensaries (*gouttes de lait*). A French crèche is a hall or ward set up in a working-class district (sometimes it is even an annex of the factory itself), where the mother can go and suckle her child without interrupting her work for more than the minimum of time necessary for feeding

the child. The woman thus submits to the necessities of factory-life without neglecting her maternal duties. Such an arrangement can be practically satisfactory only when employer and employed are in complete accord with each other. The crèche is the school of maternal lactation, and, according to the spirit of its founder, ought also to become a school of child-rearing. Professor Budin was the first to urge manufacturers to encourage lactation by the mother, to found places where children could be assembled, and to give special assistance to the suckling mothers. This assistance took the form of orders for food, and of sterilized milk for such women as could suckle no longer. The crèches contribute towards diminishing infant mortality; their aim is excellent, and it is regrettable that the French public authorities do not (as is done in Italy and Portugal) make it obligatory to establish a crèche in every factory where woman's labour is employed.

The milk dispensary is not, as one would judge from its name, merely a centre from which pure milk, sterilized or pasteurized, is distributed. As Budin understood it in 1892, and as Dr. Dufour organized it at Fécamp in 1893, the milk dispensary should encourage lactation by the mother, should keep the child under observation till the age of fifteen or twenty months, should distribute milk free from tubercle bacilli and all other germs, and should teach the mother the elements of maternal duty. At the present time milk dispensaries, under private administration, often encouraged by the State and the municipality, are rapidly increasing in number. They have never swerved from their purpose; they are now, as always, educational centres for such mothers as come asking for advice about the preservation and improvement of health, and receiving moral encouragement and pecuniary help. The milk dispensary plays an interesting part in our social arrangements. But are we entitled to count this movement as a basis for solving our great problem of the prevention of tuberculosis? This is the question lately asked at the second Brussels Congress, held in 1907, concerning milk dispensaries, and the answer was affirmative. One of the present writers, being then a French delegate charged with the preparation of a report, based his conclusions not so much on the dangers inherent in a milk which may still carry some few bacilli, as on the educative power inherent in a consulting-room devoted to babes and sucklings; and thus he supported Professor von Schrötter in his hope that the milk dispensaries may develop so as to become not only centres for all those measures which concern the baby's protection, but also important aids in the campaign against tuberculosis in early life.

Safeguarding of Children of School Age.

On November 7, 1903, Professor Grancher founded an "Œuvre de préservation de l'Enfance contre la Tuberculose." This movement, very trenchant in its method, aims at relieving tuberculous parents of the burden and care of their children, whom it finds, through the sickness of father or mother, doomed to be much neglected. It endeavours, above all, to remove the children from their daily danger of infection by quartering them in country districts, thus completely changing their environment. In his appeal, which begged citizens to enrol themselves as members of the league, Professor Grancher wrote as follows: "For a long time I have been haunted by the leading idea of Pasteur's fine book on the 'Diseases of Silkworms,' that in order to save a race that is threatened by an infectious disease, the best plan is to save the cocoon."

The "League for the Preservation of Children from Tuberculosis" continues its work in France and grows daily. The large towns, such as Lyon, Marseille, Bordeaux, Lille, Montpellier, Toulouse, etc., have established similar societies after the Parisian model. These affiliated societies receive from the Minister of the Interior their share of the money voted, but they are chiefly maintained by private liberality. At Lille action has just been modified. It occurred to one of us to subject to the test of the ophthalmic reaction the children of those sick parents who were on the books of the Emile Roux Anti-Tuberculosis Dispensary. Those children who react positively, even though there be no clinical evidence of tuberculosis, are sent to the Home Sanatorium of Montigny-en-Ostrevent; and there, grouped in homes, under the supervision of a competent officer, they undergo a treatment consisting largely of air and rest, and are not restored to their families until the ophthalmic reaction is negative. These school-parks (*parcs scolaires*)—and would there were more of them!—are likely to prove a great success. They are comparable to the French school colonies, from which they differ by the fact that their children are the subjects of latent tubercle, and not merely sufferers from poverty and malnutrition.

The *school colonies* are for such poor children as are ill-nourished and exposed to tuberculous infection. To protect these children from their besetting danger an effort is made to give them a long stay in the country (rural colonies), amongst the hills, by the seaside, and during the school holidays (holiday colonies). Voluntary associations zealously pursue this purpose. Paris subscribes £11,000 yearly to this movement, and more than 4,000 children benefit by it. The average favourable result is, according to M. Bompard, an increase of 2 kilogrammes in weight (say 4 pounds 6 ounces) and an increase of 2 centimetres (say ¾ inch) in diameter of chest.

The preventive machinery against tuberculosis comprises, in France, thirty-two rural colonies and nineteen holiday colonies. There is also an attempt at organizing what may be called a *semi-colony for school-children*, the intention being to move weak children (and, for that matter, healthy ones too) into playing-fields in the country for several hours a day. This intention has not yet been carried out.

Lastly, delicate children are taken to the seaside as well as to the country. *Marine sanatoria* have been founded not so much in order to treat children who are actually afflicted with tuberculous lesions in joints or glands, but rather in order to strengthen the constitutions of a large class of delicate and debilitated children who suffer from a malnutrition handed down from their forefathers, rather than from any downright disease. These sanatoria for the treatment of children who are delicate, ricketty, lymphatic, or scrofulous, have been built after the plan of the Arcachon Sanatorium founded by Dr. Armaingaud. To-day there are fourteen such sanatoria, the best known being those of Banyuls, Hyères, Hendaye, whither the city of Paris sends every year the weaklings of her schools.

Sanatoria for the Treatment of Tuberculous Children.

There are in France two classes of sanatoria which aim at the prevention and the cure of tuberculosis in children. The one deals with cases of pulmonary tuberculosis (Villepinte, Ormesson, Villiers); the other is concerned with tuberculosis of bones, joints, and glands. The first class consists commonly of woodland sanatoria, the other class is represented by seaside sanatoria. As the woodland sanatoria for children are in no important way different from woodland sanatoria for adults, we need not dwell on them further.

But the seaside sanatoria are meant, as we have already observed, for prevention as well as for cure. Twenty-four of these are scattered along the English Channel, the Atlantic seaboard, and the Mediterranean coast; those best known are at Berck, St. Pol-sur-Mer, Pen-Bron, Saint Trojan, Arcachon, and Cette. These stations have amongst them 3,923 beds. The seaside treatment is pursued with the best results, and the facts are so plain that we see the municipalities sending to these sanatoria every summer children who are weak or ricketty, or convalescent from illness, or, indeed, suffering from closed tuberculous lesions. The municipalities have learned that this practical help is also prudential; for they are the gainers by substituting the quicker, cheaper, and more effectual seaside treatment for the less advantageous treatment at an urban hospital. Accordingly, seaside treatment is looked upon as a powerful weapon in the campaign against tuberculosis; and the corresponding movements meet with much moral and pecuniary support from departmental councillors and from Governments.

Anti-Tuberculosis Propaganda and Public Instruction.

We mean by propaganda and public instruction to set the crown on our efforts against tuberculosis. We ask that mothers shall receive direct instruction as to the means of combating tuberculosis, being taught in crèches and milk dispensaries by the medical officer; that school-children shall receive similar instruction from their schoolmasters and schoolmistresses, or from a competent visiting master; that the middle and upper classes shall hear lectures against tuberculosis from the corps of lecturers attached to the *Public Health Leagues;* and that the working masses shall be taught the same doctrines and precepts by health-visitors drawn from their own order and duly prepared for their work. The instruction of the children in this subject can only be regarded as sufficient, if it is scientific, hygienic, and moral.

By carrying out the above programme the prevention of tuberculosis in infancy and childhood cannot fail to be promoted. Some timid attempts have been made at bringing about in France a truly rational system of education. The Girondin League of Physical Education have organized sports clubs in the secondary schools of Southern France. Much importance is attached by the heads of schools and colleges to physical exercise. Open-air schools are being founded, like the one at l'Esterel. Popular lectures are given in the secondary schools concerning hygiene, public health, and the struggle against tuberculosis. Instruction is being carried out in the schools as much by word of mouth as by text-books and diagrams. The teacher puts before the children maxims which, when duly expounded, are revealed as important truths, thus: "Tuberculosis is contagious; it becomes so by ingestion of bacilli which have escaped from dried sputum. Do not spit on the ground." The spit-cup is shown, its utility is explained, and the use of disinfectants demonstrated.

To guard against contagion we are not content with medical inspection of schools. In some towns—Nice, for example—each pupil is furnished with a record of his health in the form of a little book, which accompanies him till the end of his studies. On this record are entered his natural bodily blemishes, the illnesses he suffered in childhood and youth, illnesses which may be signs of physical debility, and may one day demand a stay at some sanatorium.

Thus the National Leagues against Tuberculosis, the Public Health Associations, the Child Protection Societies, etc., have been founded in France, partly to alleviate bodily suffering, but quite as much in order to educate the public for the battle against tuberculosis; they watch over the child's growth during its gestation, over the comfort and quiet of the parturient woman, over the nutrition of the child, over its protection from tuberculosis during infancy and childhood, over the

treatment of its tuberculosis if infection come. These movements, if they are to be effectual, must evidently be multiplied in number and co-ordinated with each other. Some legislative measures and administrative ordinances have been, or will be, enforced in support of these movements—for example, compulsory notification of infectious diseases, compulsory disinfection where a case of tuberculosis has ended fatally, inspection of workshops, slaughter-houses, dairies, etc.

In any case, limited as their resources are, the above-mentioned forms of practical effort and scientifically directed enterprise have already done excellent work. They will certainly succeed in strengthening the human soil against invasion by the tuberculous seed, and in removing the commonest means of infection. They will, moreover, help to better the people's lot, and so to increase by various means the power of the human race to resist tuberculous invasion.

XXV.

TUBERCULOSIS AMONG CHILDREN IN GERMANY.

By Professor Nietner,
M.D.,
Secretary-General of the German Central Committee for Combating Tuberculosis, Berlin.

Tuberculosis, especially in the form of pulmonary tuberculosis, plays the most important part in Germany, as in other countries, as the chief cause of sickness and mortality during the years of active adult life. Thanks to the social laws which were established as a result of the message of His Majesty Emperor William I., well called the Great, and the wise conduct of the systematic preventive measures thus made possible, the most devastating of human diseases affecting men and women has, within the last twenty years, decreased in Germany to a most gratifying extent. The official statistics bear undisputable evidence to the truth of this statement. For every 10,000 inhabitants in cities or towns in Germany of 15,000 or more inhabitants, the number of deaths from pulmonary tuberculosis has undergone a progressive decrease.

Table indicating Progressive Decrease in Death-Rate from Pulmonary Tuberculosis in Germany.

Years.	Mortality Rate per 10,000.
1877–1881	35·8
1882–1886	34·6
1887–1891	30·4
1892–1896	25·5
1897–1901	21·9

The mortality rate in Prussia has undergone a similar diminution:

TABLE INDICATING PROGRESSIVE DECREASE IN DEATH-RATE FROM PULMONARY TUBERCULOSIS IN PRUSSIA.

Years.	Mortality Rate per 10,000.
1885	31·0
1890	28·0
1895	23·5
1900	21·0
1901	19·54
1902	19·04
1903	19·64
1904	19·21
1905	19·13
1906	17·28

Occurrence of Tuberculosis in Early Life.

Unfortunately this gratifying result is not the same at all ages. In youth this diminution of the mortality is exceptionally small; and at the ages of from five to ten years and from ten to fifteen years an actual increase in the death-rate from tuberculosis is manifest.

The degree of mortality of tuberculosis in children at the various ages is illustrated in the statistics of the year 1902.

TABLE INDICATING MORTALITY RATE FROM TUBERCULOSIS AMONG CHILDREN IN GERMANY.

Age.	Number of Deaths.	Mortality Rate from Tuberculosis among 1,000 Children.
Under 1 year	19·65	9·4
1–2 years	15·18	32·2
2–3 „	8·51	46·1
3–5 „	5·90	58·4
5–10 „	4·67	92·7
10–15 „	5·84	211·9

According to the above table it would appear that the beneficial influence of modern anti-tuberculosis measures had affected principally the adult population, and that infants and children, and especially those of school ages, had not profited by the same, or, at all events, not to an equal extent. This is probably the result of the social legislation which hitherto has only taken into consideration and placed under its care and protection those of adult years. It is essential in future to give greater attention to the protection of all children up to their fifteenth year against tuberculosis in all its many and varied forms.

The merit of having repeatedly and energetically emphasized this need for the protection of child-life is due to Martin Kirchner, of Berlin.

The wisdom of this course has of recent years been recognized more and more. The war against tuberculosis during childhood is, consequently, now being carried on in Germany with rapidly increasing effectiveness. If we would prevent tuberculosis, we must not only seek to eradicate the malady from among adults, but must take steps to prevent infection during infancy and childhood. The disease must be recognized at as early an age as possible, and effective measures taken to deal with it adequately. Most patients who become tuberculous and die at the beginning of maturity have not acquired the disease in maturity, but have been infected with the tuberculous germ during childhood, and have grown up waging a constant struggle with the same, until at last the disease has predominated. It must be remembered that during the years of youth, and especially at the period of puberty, and when with the commencement of industrial life the individual is subjected to great physical strain, a latent tuberculosis is only too wont to spring up into a fatal activity.

Early Diagnosis and Treatment.

It is of primary importance to be able to distinguish tuberculous subjects at the earliest possible moment, and to afford them appropriate treatment for their own benefit; and also, under all circumstances, to prevent them from transferring their disease to the healthy, especially healthy children. To this end the establishment of anti-tuberculosis dispensaries and information bureaus for patients with pulmonary tuberculous disease are most effective measures. Their object is to supply information regarding the best means possible for the prevention of the disease, the cure of the diseased, and the protection of their children and associates from infection. Such central information and providing offices can therefore be considered as being the centre of all preventive measures against tuberculosis. By the decree of the Minister of Public Worship, Education, and Medical Affairs, of December 28, 1903, these offices have been established in Germany on a large scale, in virtue of the experience gained in Belgium and France with the similar anti-tuberculous dispensaries. The latter have not exactly been reproduced, but have been adapted to German conditions. The officials of the information and providing offices, after having determined the existence of tuberculosis, examine the entire family of the sick person, so as to discover the members already infected as early as possible, and to treat them at the stage of the disease when a cure may still be possible. By instructing the sick, as well as their relatives, as to the mode of dealing with the expectoration, the cleaning of the linen of the patient, the care and ventilation of the rooms, the nutrition of the sick, and above all, the proper management of the children, much is being accomplished towards securing reasonable means of protection against infec-

tion. A spread of the disease within the family may be, if not actually prevented, at least rendered less certain. Those members of a family found to be already infected, or especially threatened, are immediately placed under medical treatment. The tuberculous sick are dealt with

FIG. 12.—CHILDREN'S SANATORIUM, "HERZOGIN MARIE," AT ORANIENBAUM.

in a sanatorium, a hospital, or some other institution, and provided with permanent care. The importance of this arrangement is made evident from the fact that within about three years the number of information offices has increased from two to more than 220, and new centres are constantly being opened. The greater part of these information and

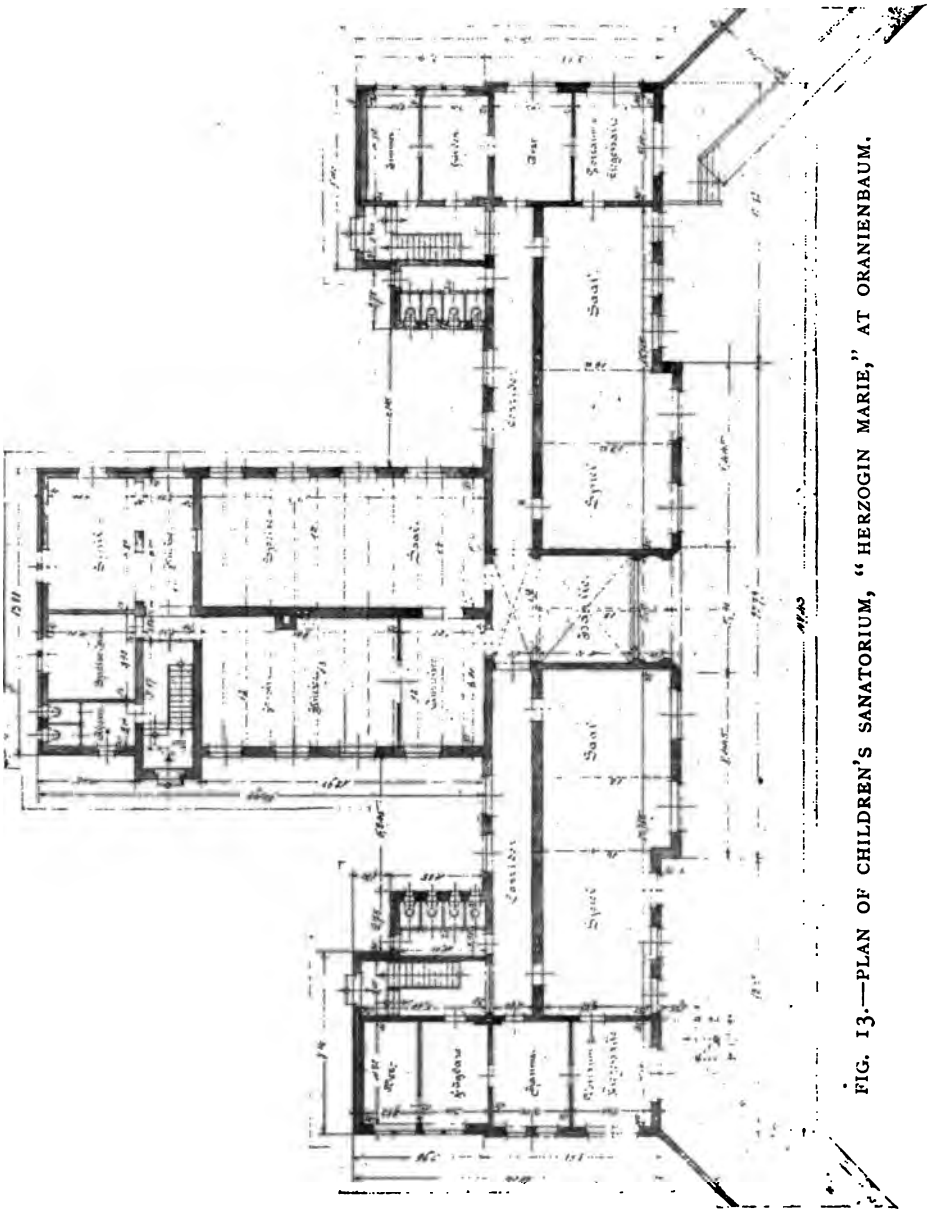

FIG. 13.—PLAN OF CHILDREN'S SANATORIUM, "HERZOGIN MARIE," AT ORANIENBAUM.

providing offices have so far been established in Germany by private enterprise or benevolent societies. They are also being established, in continually increasing numbers, by sick funds, and especially by the municipal authorities. For conducting these information and providing offices it is necessary that all agencies of public and private welfare should loyally co-operate.

Of course it is not possible with the aid of the information and providing offices alone to effectively compete with the vast amount of tuberculosis occurring in childhood. For this purpose a large number of other arrangements and institutions are necessary, whose object it is in part to cure those already affected, but largely to protect the healthy against infection. As in all acute infectious diseases, so in tuberculosis, as a chronic public disease, the preventive measures against its occurrence are of greater importance than those for its cure.

Institutional Treatment of Tuberculous Children.

The numerous children's health establishments scattered throughout Germany serve, in a great measure, for the treatment of tuberculous cases. These establishments may be divided into (1) those dealing with children already suffering with pronounced tuberculosis, either of the lungs, the bones, or the joints, and (2) those only receiving in treatment children who are "scrofulous" or of a tuberculous predisposition without being cases of open tuberculosis likely to prove centres of infection. The number of the first group of institutions is at present 18, with 750 beds. But a very active movement is in progress throughout the whole country which seeks to considerably increase the number of these establishments (Figs. 12, 13 and 14). For "strumous" cases and those children threatened with tuberculosis, 73 institutions with 6,000 beds—besides several hundred others only used in the summer—are now available in Germany.

Prophylactic Measures.

In discussing preventive procedures it is necessary to differentiate between infancy, early childhood, and school age.

In infancy the chief mortality from tuberculosis is due principally to tuberculous meningitis and miliary tuberculosis. Pulmonary tuberculosis does not play a large part during the first year. Through improper and faulty nutrition—conditions exceptionally common in our large cities—a large proportion of the children are insufficiently and imperfectly developed physically, and thus are especially predisposed to tuberculous infection. Whether this really takes place principally during childhood, as von Behring claims, or whether the children are only specially predisposed to infection by imperfect nutrition with tuberculous cows' milk, is still an open question. It does not, however,

really alter markedly our attitude in the anti-tuberculosis campaign against this disease of childhood. At the initiative of Her Majesty the Empress, an extensive movement has begun throughout Germany, which aims at decreasing the frightful mortality among infants, especially marked in our large cities.

Everywhere private societies, communities, and municipal and

FIG. 14.—CHILDREN'S SANATORIUM AT BELZIG.

State authorities have combined to secure means which shall diminish the death-rate of infants by instructing mothers in the methods whereby they may best nourish their infants, on the necessity for self-nursing, and also on the importance of good and pure milk free from tuberculous organisms or other disease-producing elements.

The principal danger for children of more advanced age lies in being infected by tuberculous members of the family. Tuberculosis is a

family and dwelling-house disease. Its spread must consequently be prevented, either by isolating the sick within their homes, so that they may no longer act as a danger to their family, or by removing the sick from their family or the healthy from the neighbourhood of the sick members. Besides the attending physician, the information and providing offices are responsible for the care and, if necessary, isolation of the sick in their homes. When possible, they arrange for the sick to be removed from the family. This is done by sending those patients still considered curable to sanatoria and like health establishments, while those in a more advanced stage of tuberculous disease are dealt with in hospitals, invalid homes, or asylums. For this purpose 97 public health establishments for curable cases and 36 private health establishments with 12,000 beds have been established throughout Germany. Unfortunately, those in an advanced stage of consumption cannot as yet be provided for in sufficient numbers. This is partly due to the comparative scarcity of special institutions for these patients, and also to the insufficient number of specially equipped wards in the State Hospitals. The difficulty is also accentuated by the patients themselves often preferring, perhaps not unnaturally, to spend the last years of their life among their family and near relations, irrespective of the danger to which they expose their children and friends. There is no compulsory power to ensure removal to a proper institution. Among the institutions which provide for the prophylactic care of children special mention should be made of the numerous marine stations or seaside hospitals; and also the saline baths found in many parts of Germany.

A thorough prophylaxis of tuberculosis has been made possible by the Imperial Constitutional Law of 1905, whereby pulmonary and laryngeal tuberculosis are classified among the infectious diseases. Unfortunately the obligatory notification and disinfection resulting from this law are, according to the regulations, required, in most German confederate states, only in cases of death resulting from pulmonary or laryngeal tuberculosis. It is to be regretted that the Parliamentary bodies have not resolved to extend these regulations also to cases of sickness, certainly representing a direct danger to the surroundings. Everywhere this is recognized as being a decided shortcoming, especially as, under the existing conditions, it is impossible to carry out the so necessary obligatory disinfection of dwellings after the removal of the sick. Prophylactic measures have, nevertheless, been essentially facilitated by the law and its regulations, especially by the introduction of the obligatory final disinfection. The training of official disinfectors in special training schools, and the decree of the above regulations, guarantee an effective disinfection.

FIG. 15.—FOREST SCHOOL AT CHARLOTTENBURG.

Tuberculosis and School-Children.

Although a large number of children afflicted with tuberculosis are at the age of school attendance, the school is only responsible, to a small extent, for the spread of tuberculosis. Experience has shown

that the number of teachers and pupils with an *open* tuberculosis is very small indeed in Germany. But it is certain that every teacher and pupil liberating tubercle bacilli with the expectoration represents a great danger to the surroundings, and should, therefore, be excluded from all educational establishments.

In this respect the decree by the Prussian Minister of Public Worship, Education, and Medical Affairs, of July 9, 1907, is of great importance. This law requires that all teachers and pupils suffering with pulmonary or laryngeal tuberculosis are to be excluded from school attendance if, and

FIG. 16.—OPEN-AIR SCHOOL AT MÜNCHEN, GLADBACH.

as long as, their expectoration contains tubercle bacilli. The spread of tuberculosis through the schools is further prevented by the strict observance of hygienic principles in the construction and management of the school buildings and by a hygienic arrangement of the curriculum. Light and air in all the rooms and corridors, careful ventilation and cleansing of all rooms, the employment of dust-suspending oils for the floors, a rational alternation of instruction with recess and physical and mental culture, constitute important prophylactic measures. Gymnastics and games for the young, as well as the establishing of school-baths, are also of much service. The establishment of public kitchens for children, and the distribution of milk and lunch among school-children during the cold seasons of the year, afford excellent measures against tuberculosis.

The co-operation of school authorities in the early recognition of tuberculous diseases is of especial importance. For this purpose the appointment of school physicians is essential. There are already many at work in Germany, and they are continually increasing in number. The physicians subject all school-children, not only upon entering the school, but periodically, to a thorough examination. Recently separate classes, and in some large centres, separate schools, have been established for physically weak children. The praiseworthy example set by the city of Charlottenburg in erecting a *forest school* for 214 children—which is soon to be enlarged—deserves to be, and has been, extensively followed (Figs. 15 and 16).

Special Institutions for Children.

Among special institutions for the invigoration of school-children, especially those threatened with tuberculosis, the following may be mentioned:

The *vacation colonies*, to which delicate children requiring special care are sent, for from four to six weeks, during the long summer vacation. These colonies are located either among the extensive forests surrounding many of the large German cities, or in the country or on the sea-coast.

The "Berlin Society for Vacation Colonies" alone has thus assisted over 70,000 children at an expense of 2,500,000 marks. Of these 17,000 have had courses of saline baths, 13,000 have been at seaside stations, 18,000 in the country, and 22,000 elsewhere. "The Society for Children's Health Establishments on the German Sea-coast" sends annually about 18,000 children to its various homes on the North Sea, and from 500 to 600 to the Baltic Sea. The forest health establishments for children have the same object, but they are even more effective, insomuch as they are open during the entire summer. These forest health establishments have the advantage of being located in the vicinity of the child's own home. During the day the children remain in the forest school, where they receive simple but nourishing board and simple instruction. At night they return to their home. The results attained by these forest health establishments have been excellent. Of late, acting in accord with the example of Grancher in Paris, attempts have been made to deal with children belonging to tuberculous families by boarding them out in the country. As yet no opinion on the results of these measures is possible, as, so far, this plan has only been tried on a small scale. So as to accustom the children, dismissed from the children's health establishments, to muscular work —to awaken their interest for nature, and possibly to give them an inclination for gardening—a farm-colony has been established in the

neighbourhood of Berlin. The boys are here employed in gardening, and the girls besides in household work and the raising of small live-stock (Fig. 17). A definite opinion on the results of this establishment cannot yet be given, the undertaking being too new.

The war against tuberculosis in Germany has by no means come to a standstill. Everywhere an advance with new and keener weapons is quietly, but not the less energetically, going on. The importance of

FIG. 17.—TUBERCULOUS CHILDREN ENGAGED IN GARDENING AT HOHEN-LYSHEN.

arresting the spread of the disease, especially during childhood, has till recently not been sufficiently realized. Now, however, it is being taken up with ever-increasing zeal and knowledge. We may therefore hope that before long it may be possible to show a marked diminution in the sickness and mortality rate of tuberculosis among the valuable lives of our children—our Empire's coming men and women.[1]

[1] For those desirous of studying in further detail the various enterprises now at work in the German Empire for the Prevention and Treatment of Tuberculosis among Children, the following references may be of service:

Reports of the German Central Committee for Combating Tuberculosis (Jahresbericht des Deutschen Zentral-Komitee zur Bekämpfung der Tuberkulose, Eichhornstrasse 9, Berlin).

Reports of the Association for Children's Sea-side Resorts (Jahresbericht des Vereins für Kinderheilstätten an den Deutschen Seeküsten).

Report of the Association for Vacation Colonies (Verein für Ferienkolonien.)

Dietrich: "Ueber Kinderasyle," *Jugendfürsorge*, Heft 2-7. 1906.

Damaschke-Langensalza: "Wohnungsnot und Kinderelend," *Beiträge zur Kinderforschung u. Heilerziehung*, Heft 11 (Dwelling Calamity and Children's Distress).

Schmid-Monnard: "Soziale Fürsorge für Kinder im schulpflichtigen Alter," *Handbuch der Hygiene*, Bd. iv.

Fränkel, B.: "Die Kinderheilstätte Belzig," *Zeitschrift f. Tuberkulose u. Heilstättenwesen*. Bd. v., Heft 1. Leipzig, 1903.

Düttmann: "Katholische Kinderheime an der Nordsee," *Charitas*, 7-8, 1902.

Baginsky, A.: "Kinderheil-und Erholungsstätten," *Zeitschrift des Vereins für Armenpflege*, Heft 80. 1907.

Baginsky, A.: "Ueber Massregeln zur Bekämpfung der Kindertuberkulose." Berlin, 1907.

Kirchmer: "Verbreitung und Bekämpfung der Tuberkulose im Kindesalter," *Verhandlungen des Deutschen Central Komitees*, 1906.

XXVI.

TUBERCULOSIS AMONG CHILDREN IN NORWAY.

By Kr. F. ANDVORD,

M.D.,

Member of the International Committee for the Prevention of Tuberculosis.

To determine with exactness the amount of sickness and mortality from tuberculosis among children in Norway is as perplexing as it is in most other countries. The principal reason for this is the difficulty in diagnosing many of the forms of tuberculosis in early life, and especially during the first few years. In Norway, also, no small number of children, especially in country districts, die without having come under medical observation. The state of affairs in this respect is, however, rapidly improving, and at the present time the cause of death is known in as many as 86 per cent. of all cases. A large proportion of the mortality from unknown causes still, however, continues during the first years of childhood.

Mortality from Tuberculosis.

During the last twenty to twenty-five years of the last century the death-rate from pulmonary tuberculosis in the districts least affected can be put at about 1 per thousand among the living, and about 10 per cent. of all deaths from known causes.[1] In the districts in which tuberculosis is most common the mortality stood at about 5·5 per thousand of the whole population, and formed about 22 per cent. of all deaths. Of the remaining tuberculous affections (meningitis, miliary tuberculosis, and scrofulo-tuberculosis), the corresponding figures were about 3 per thousand and 3 per cent., 1·5 per thousand and 6 per cent.

In the general death-rate of children under one year of age there is some indication of the frequency of tuberculosis. It appears that the total death-rate among children during the first years of life living under conditions otherwise similar, both in town and country, is

[1] Andvord, Kr. F.: "Studier over Tuberkulosens Forekomst i Norge," *Norsk Magazin for Lægevidenskaben*, No. 12. 1895.

invariably higher or lower according to the frequency of pulmonary tuberculosis in the same community. In six rural medical districts, with very low death-rate from pulmonary tuberculosis (about 1 per thousand), the average total death-rate of children in the first year was about 70 per thousand; in five other rural medical districts, with a very high death-rate from pulmonary tuberculosis (about 4·8 per thousand), the total death-rate of children during the first year of life was about 97 per thousand. In five small towns, with little tuberculosis (about 2·4 per thousand), about 100 per thousand; and in six other small towns, with much tuberculosis (about 4·3 per thousand), about 120 per thousand, total death-rate during the first year of life.

In Christiania, with a population of about 175,000 inhabitants, during the years 1880-1890, there was a death-rate from pulmonary tuberculosis of about 3 per thousand, and a total death-rate for children in the first year of life of 164 per thousand. The population in 1906 was about 225,000, but in spite of this the mortalitypulmonary from tuberculosis has now fallen to about 2·2 per thousand, and, concurrently, the total death-rate during the first year of life has dropped to about 150 per thousand.

Further, with regard to the frequency of tuberculosis in the various years of childhood, it can be stated that during the five years 1887-1891 the percentage relative to known causes of death shows the following averages in the Norwegian towns taken collectively:

TABLE INDICATING DEATH-RATE FROM TUBERCULOSIS IN NORWAY AMONG CHILDREN OF DIFFERENT AGES.

Year of Childhood.	Mortality Rate from Tuberculosis.
1st year	5
2–5 years	14
6–10 ,,	27
11–15 ,,	42

In three of our largest towns, Christiania, Bergen, and Trondhjem, the death-rate per thousand of the living during the same period is as follows:

TABLE INDICATING DEATH-RATE FROM TUBERCULOSIS IN CHILDHOOD IN NORWEGIAN TOWNS.

Age in Years.	Christiania. Per Thousand.	Bergen. Per Thousand.	Trondhjem. Per Thousand.
0–1	6·3	8·2	11·0
2–5	4·3	6·0	7·7
6–10	2·4	2·1	3·0
11–15	2·1	1·8	4·1

Clinical Considerations.

In regard to the clinical aspects of our subject, we may refer to the works of Nicolaysen[1] and Randers. According to the former, of the 4,186 children under fifteen years of age treated in the Children's Department and the Polyclinic of the Rigshospital in the course of the years 1893-1895, 8·3 per cent. were suffering from some form of tuberculosis. Professor Aksel Johannessen[2] has stated that while tuberculosis is relatively rare during the first six months of life, it steadily increases after the first year, and reaches its maximum in the second and third years, when about one-third of all children are the subjects of some form of tuberculosis. Of the cases above referred to, 8·3 per cent. (347 children) with clinical signs of tuberculosis, 34 per cent. were returned as "scrofulous," 30 per cent. had tuberculous bones and joints, 6 per cent. tuberculous peritonitis, and 3 per cent. tuberculous meningitis.

Randers[3] has supplied us with valuable statistical returns from his private Polyclinic in Christiania during the years 1899-1900, and also from an investigation of tuberculosis among the school-children of one of Christiania's Government schools in 1900. The first statistics include 1,617 children under five years of age; and among these tuberculosis of the respiratory organs was found in 6 per cent., and tuberculosis of all kinds (gland tuberculosis included) in 20 per cent. The second returns deal with 1,300 school-children between the years seven and fourteen, and among these tuberculosis of the respiratory organs was found in 1 per cent., and a more or less disseminated, latent, "closed" gland-tuberculosis, partly in connection with scrofulous affection of mucous membranes, in 26 per cent.

Pathological Investigations.

Dr. J. Bugge,[4] in an analysis of 200 post-mortems, undertaken with the main object of ascertaining the frequency of latent tuberculosis as well as of active forms of the disease, found that in twenty-one post-mortems on children under one year of age, death from tuberculous lesions occurred only in one case (5 per cent.); while in the twenty-two post-mortems between the ages of one and nine, twelve (54 per cent.) succumbed to tuberculous disease. Among the remaining ten, latent tuberculosis was found in three (30 per cent.), and all these were of a virulent character. Between the ages ten to nine-

[1] Nicolaysen, Lyder: "Om Tuberkulosens Hyppighed og Ytringsformer i den Tidligere Barnealder," *N. M. F. Lægevidenskaben*, No. 1. 1898.

[2] Johannessen: Report of the Medical Society, p. 249, 1896.

[3] Randers, E.: "Tuberkulosen i Barnealderen. Kliniske Iagttagelser," *N. M. F. Lægevidenskaben*, p. 221. 1902.

[4] Bugge, Jens: "Undersögelser om Lungetuberkulosens Hyppighed og Helbredelighed." 1896.

teen, in eighteen post-mortems, six (33 per cent.) showed evidence of tuberculosis having been the cause of death; and among the remaining twelve no less than ten (83 per cent.) proved to be the subjects of latent tuberculosis. Of these ten, again, six were of a virulent character; the remaining four, on the other hand, were so-called "cured" cases. We may conclude with Naegeli, that latent tuberculosis of the earliest years of life is most frequently of a virulent character, whilst the state of affairs is reversed in the case of so-called "cured" cases, the occurrence of these changes, increasing with the years, being greatest in the age division fifty years and upwards.

It is especially with regard to the first years of life that Professor Harbitz[1] arrives at new and most interesting conclusions. He, as well as Bugge and other investigators, find latent and obsolete tuberculosis to be of rare occurrence during the first two years of life. But he also shows by reports on a series of post-mortems (1901-1904) on seventy-five infants under one year of age that the existence of latent tubercle bacilli in the glands, especially the cervical glands, occurs to the extent of 15 per cent. In these cases (eighteen of the total 142 children examined post-mortem) he was, in fact, able, by inoculating into animals material taken from the lymphatic glands, to demonstrate the presence of virulent tubercle bacilli in cases presenting no evidence of disease, and where no signs were visible, either in the infected glands or in the other organs, and where, also, by careful microscopic examination, it was impossible to discover either tubercles or tuberculous granulations. These interesting results, have, as we know, now been corroborated by Bartel and Weichselbaum in Vienna, Calmette in Lille, and Gaffky in Berlin.

Professor Harbitz comes to the conclusion that latent and obsolete tuberculosis, principally of the bronchial glands, steadily increases from the third and fourth years to ten to fifteen years. In cases dying from causes other than tuberculosis it is found in 50 to 60 per cent.

Prophylactic Measures.

The law dealing with tuberculous diseases, passed in 1900, by which the notification of certain forms of tuberculosis was rendered compulsory, has done, and is doing, good service. This law was due in great measure to the work of Dr. Holmboe and Dr. Klaus Hanssen. It came into force at the beginning of 1901. Compulsory notification was mainly introduced in order to give the health officer an opportunity to exercise sufficient control with regard to the cleanliness to be observed in the houses of the sick, especially as to the disposal of their secretions; and in case of death or removal, to see that a radical cleansing is made

[1] Harbitz, Francis: "Untersuchungen über die Haufigkeit, Lokalisation und Ausbreitungswgge der Tuberkulose." 1905.

of the premises occupied by the deceased, and also of wearing apparel, bedclothes, etc., before others make use of them. The attending physician is obliged to see that cleanliness is maintained in the home of the patient. Should he not be able to enforce this, it is his duty to report the matter to the health officer, who then has to undertake the sanitary supervision, which he also has to do in such cases where the sick person is not under the care of a physician. *The School Bill* of 1902 insists on the carrying out of regulations for cleanliness in schools.

Sanatoria and "pleiehjem" (nursing homes) are doing much to stamp out the disease. Two public sanatoria and seventeen private sanatoria now exist in Norway for the treatment of pulmonary tuberculosis occurring in adults. There are also fifteen "pleiehjem" (nursing homes) for country districts, and, in addition to these, many of the larger towns in connection with their local hospitals have erected special departments, partly in separate buildings, for tuberculous patients.

I feel certain that the decrease in the total mortality, and, under the first year especially, must be due to the decrease of tuberculosis. Without doubt this follows from the fact that acute and especially chronic cases of consumption are more and more kept away from association with infants and children.

Treatment.

Under this heading we may take into consideration the two seaside hospitals for scrofulous children—the Seaside Hospital at Fredriksværn, the chief physician of which is Dr. Sinding Larsen; and Hagevik Seaside Hospital near Bergen, the chief physician of which is Dr. Gade. Both these establishments have 100 beds each, and have been erected by private initiative, and are worked now with official help on the condition that the price charged for each patient per day must not be higher than 1 kr. (equals 1s. 1¼d.).

Dr. Sinding Larsen has kindly provided the following description of the institution of which he is the responsible head:

"The seaside hospital at Fredriksværn—*the first in Norway*—was established in 1892 by a board, presided over by Queen Sophia, by money supplied by the royal family, numerous private people from the whole country, and by Christiania's company for 'liquor selling' (the Gothenberg system).

"Its object is the treatment of scrofulo-tuberculous children between seven and fifteen years of age. Tuberculosis of the lungs is not received.

"The hospital is situated one or two kilometres from Fredriksværn, at the west side of the mouth of Kristiania Fjord, quite near the shore in an old wood of pines. The climate is a soft seaside climate.

"The hospital consists of a wooden main building with accommo-

dation for 100 patients, one epidemic building for twenty to thirty patients, and the necessary buildings of management. It has its own establishment for electric light and for disinfection. The cost of the whole hospital, furnishing included, was about 200,000 kr.

"The working expenses are about 1.50 kr. per day. The patients are only charged 1 kr. per day, which is partly paid by the parents or other private persons, societies, legacies, or the poor rates. The difference between the expenses and the payments is covered by help from the Government—15,000 kr. a year.

"The hospital has two physicians; eight nurses provide the attendance. Until now a little more than 1,200 patients have been treated. Of these, 27·8 per cent. have been mere superficial tuberculosis, scrofulo-tuberculosis (in the integuments), 20 per cent. lupus and tubercle of the glands, 49 per cent. tuberculosis of the bones, spine, and joints, and 3·1 per cent. visceral tuberculosis.

"The treatment has been dietetic, hygienic, and orthopædic. Open-air treatment, plenty of food (milk, eggs, flesh, fish), baths, partly in the sea (in the summer), partly in salt water in the hospital (all the year). Internal medication is of very little importance.

"The children for one hour a day are instructed in the ordinary school subjects.

"There is a good deal of surgical work. We operate when time can be saved by operation without any functional damage or injury to the patient. The time of treatment is on an average 300 days, but varies for the different affections, though it is mostly for 'Pott's disease' and coxitis about one and three-quarter years. The results of the treatment are: Considerably improved, 70 per cent.; improved, 13 per cent.; total, 83 per cent. Not improved, 8·5 per cent.; dead, 8·5 per cent.; total, 17 per cent. Of the causes of death, meningitis and miliary tuberculosis make 50 per cent., other consequences of tuberculosis (amyloid disease, marasmus, etc.), 25 per cent."

With more careful inspection of school-children it may be hoped that tuberculous cases will be recognized at an earlier stage. The steady progress of the anti-tuberculosis movement generally throughout Norway is accomplishing much for child-life as well as for people of all ages.

XXVII.

TUBERCULOSIS AMONG CHILDREN IN SWEDEN.

By O. D. BARR,
M.D.,
Physician to the General Orphan Asylum, Stockholm.

In Sweden the campaign against tuberculosis as a national disease was commenced comparatively recently, for it is only during the last decade that any vigorous efforts have been put forth to overcome it.

The first step may be said to have been taken in 1897, when King Oscar II. handed over the sum of money which had been collected as a national subscription to commemorate the twenty fifth year of his reign, amounting to 2,200,000 kronor, as a fund to be employed for erecting public consumptive sanatoria.

The care of the sick is regarded in Sweden as a matter of public concern, and it devolves upon the local administration to see that sufficient provision is made to meet the requirements of the area under their charge. Municipalities and other administrative bodies have always shown great generosity in sanctioning the applications made for the support of hospitals of all sorts, and, as a consequence in part of that liberality, the care of the sick has attained to a very high state of efficiency in this country. That public administrative bodies, and even the State itself, have been alive to the importance of the campaign against tuberculosis is evident from the number of questions bearing upon the disease and the problem of its eradication that have been brought forward and publicly discussed. The comparative dearth of practical results of those discussions is presumably to be attributed to the uncertainty that prevails up to the present regarding the most suitable methods of setting to work to combat tuberculosis. Hence it has been left for private initiative and enterprise to take the lead in this department, as in many others. Private individuals, companies, and associations, and more especially the Swedish National Anti-Tuberculosis Association, which was founded in 1904 through the instrumentality

of the Swedish General Medical Association, have directed their endeavours towards the establishment of experimental stations and laboratories, where such new methods as are suited to the special social and economic conditions prevailing in Sweden can be studied, tested, and elaborated. A large section of the work involved in those experiments for carrying on the anti-tuberculosis campaign has been concentrated upon cases of tuberculosis in children.

Institutions for Tuberculous Children in Stockholm.

In the St. Göran's Hospital in Stockholm fifty beds have been allocated to children who are definitely affected with tuberculosis of the lungs. The building where this section of the hospital is housed was built in 1907, and is quite up to date in its appointments. The city of Stockholm furnished the funds for its erection and equipment, and it is open to children belonging to Stockholm whose parents are in such poor circumstances as not to be able to pay for them. Children of well-to-do parents are admitted to any of the private sanatoria. At the public sanatoria for consumptives there are no children's beds, and they are only admitted to the ordinary hospitals to a very limited extent. Consequently, the vast majority of consumptive children have to be tended and nursed in their own homes or in the State infirmaries.

Marine and Other Special Sanatoria for Tuberculous Children.

Children suffering from tuberculosis of the glands or bones are, as a rule, only admitted into the ordinary hospitals when they need surgical treatment. In the children's hospitals they are admitted so far as space allows. Thus, in the largest hospital of that kind, the Crown Princess Louisa's Hospital for Children in Stockholm, there have been on an average 231 children suffering from tuberculosis during the last two years.

To meet the needs of these children especially, seaside sanatoria have been lately erected and holiday colonies established for the less serious cases and for so-called scrofulous subjects.

On the West Coast of Sweden there are now two seaside sanatoria open all the year round, and furnished with an up-to-date equipment in every respect. They are the Crown Princess Victoria's Sanatorium at Skelderviken and the Styrsö Sanatorium, near Gothenburg.

The former was opened in 1903, and could then receive seventy patients; at present, thanks to a grant from the Riksdag, it is being enlarged so as to give room for 150. In the summer-time there are about 150 children boarded out in the immediate vicinity of the sanatoria, and these are superintended and looked after by the resident medical officer of the sanatoria. The Styrsö Sanatorium was only finished in 1908, and can accommodate seventy children. Both these

seaside sanatoria owe their existence to private liberality, and are principally intended for children of necessitous parents; in age they vary between three and fifteen, and are for the most part victims of scrofulous gland and bone tuberculosis. Consumptive cases are only admitted very exceptionally. At Styrsö the majority of the children are treated free of charge. The cost per day per child has varied between 1·63 and 1·57 kronor.

Besides these large sanatoria there also exist a number of seaside and mountain sanatoria for children. They are organized in conjunction with holiday colonies, very much on the Swiss pattern. The plan of dispatching groups or colonies of delicate and scrofulous school-children from the large towns was devised and acted upon in the eighties. At first children were sent chiefly to the seaside, but later also to forest and mountain districts. For the benefit of these holiday colonies small sanatoria were erected; they could only be used, however, in the summer-time, as the buildings were not substantial enough to withstand the rigours of a Northern winter.

As examples of these small sanatoria there may be mentioned "Bygdeå," situated in Norrland, with twelve beds; and "Apelviken," on the West Coast of Sweden, with twenty-four beds.

The average duration of a stay in the country is usually two months. The number of children sent into the country every year has latterly exceeded 4,000. The cost of these holiday colonies has been defrayed partly by contributions from the administrative bodies of the district and partly by private subscriptions. The cost has worked out at from 51 to 68 öre per child per day.[1]

Children suffering from lupus are treated at the Finsen Institute, a department attached to St. Göran's Hospital in Stockholm, at the charge of the State.

Prophylactic Measures.

In recent years systematic attention has been given—principally by the Swedish National Anti-Tuberculosis Association—to the question of how best to provide nursing care for consumptive patients in their own homes; and how to protect healthy children from tuberculous infection. Especially in *urban* districts, as in Stockholm, an interesting experiment has been made by renting a large house to be used for workmen's dwellings, the various tenements in it being let out to working men's families in which father or mother, or both, have the taint of consumption, but the children are well and healthy. These families obtain certain advantages, though they have to submit to following out very strictly the directions and orders given them by the doctor engaged in making the investigation. The hygienic supervision

[1] There are 100 öre to each krona, and a krona is equivalent to 1s. 1½d., or 0·26 cents in American coinage.

of the families is entrusted to a specially appointed nurse who resides on the premises. A great point is made of keeping the invalids entirely away from the children at night-time. There are now twelve or thirteen families living under these conditions, and they have among them thirty apparently healthy children. The attempt has been made to keep an eye not only on the present inmates, but also on those who have resided there previously. Several years must elapse, however, before any definite conclusion can be come to as to the results of this experiment.

As regards the *rural* parts of Sweden, there has been one experiment made in a very remote and impoverished parish in the most northerly part of the country, with very poor means of communication and, comparatively speaking, a sedentary population, among whom consumption is very prevalent. The arrangements set on foot at "Hälsan" (Health), as the institution is called, embrace a sanatorium with a resident doctor and nurses, a cottage hospital, a receiving-home for healthy children while under observation, a consumptive ward with up-to-date equipment, and baths, etc. The population of the parish, 2,300 in number, are examined by the doctor attached to the institution. The dwelling-houses are inspected and hints are given as to improvements of various kinds in the sanitary or hygienic conditions in which the people are living; advice is also tendered as to the proper care and nursing required by any invalids, and as to the measures desirable for protecting the children. A thorough-going investigation is also made into the condition of the farmyard stock of cattle throughout the parish by means of tuberculin. The results of the experiment now being conducted in that northerly parish will be attainable in a few years' time, when another complete examination of the inhabitants will be made.

The idea of removing the children of consumptive parents from their homes into other surroundings, where they will not be exposed to infection, has been taken up principally by the Swedish National Anti-Tuberculosis Association. There have been committees appointed by them in six of the "läns," or administrative districts of the country, so called "Care of the Children Committees." To enable them to carry on their work a sum of 50,000 kronor has been allotted to them from the funds of the Association. Two children's homes have been established for this branch of the work: "Sparfvebo," containing thirty beds, and "Kungsör" Children's Home, with twenty beds. In these establishments the children are kept pending the discovery of a suitable family, free from the tuberculosis taint, with whom they can be boarded. The children who are taken in hand for this purpose must be quite healthy, and their parents must have expressed a willingness for them to be dealt with in this manner. The foster-parents' homes, as well as

the children living in them, are medically inspected periodically. The "Care of the Children Committees" work in conjunction with the dispensaries, wherever such are to be found.

The first dispensary was established in Stockholm in 1905, and at the present time there are dispensaries in five of the large towns. They are modelled on the French pattern. The dispensary in Stockholm was resorted to last year by 2,400 persons.

During the present year a medical examination of all the elementary-school children in Stockholm has been carried out by specially qualified medical men, in order to ascertain the extent to which tuberculosis prevails.

Particular attention has been given to milk as a source of infection for children. During the last ten years the Riksdag has voted considerable sums of money for the combating of bovine tuberculosis; for instance, 565,000 kronor to researches with tuberculin. In the large towns the Boards of Health have issued very stringent regulations regarding the sale of milk. Thus, in Stockholm, milk sold under the designation of "Children's Milk"—*i.e.*, milk suitable for babies—must have come from a farm which is under the constant control of a veterinary surgeon specially appointed for the purpose, who shall test the stock of cows every year with tuberculin. The milk must, furthermore, be sent to the consumer in bottles which shall be sealed up at the farm under due control.

The so-called Goutte de Lait Societies deserve mention in this connection too. The first one was set up in Stockholm in 1901, and the system has since then spread very rapidly, there being societies of the kind in twenty-one towns. They are all under the supervision of doctors. They do not, as a rule, provide for nursing mothers and babies. Two of the societies, however, have recently taken up this special branch. There are some 275 children in Stockholm in receipt of milk every day from the Goutte de Lait Societies.

Methods of Instruction.

The spread of information, which is of such vital importance in the anti-tuberculosis campaign, has been carried on very vigorously in Sweden, chiefly by the distribution of literature in the form of tracts, pamphlets, and school manuals, but also by lectures and instruction in schools. The organizing of bureaux of information and the establishment of tuberculosis museums have done much to help.

As knowledge regarding tuberculosis has reached an ever-enlarging circle of people, the campaign against the malady has aroused an increasingly active interest in all classes of society; therefore it is reasonable to hope and believe that the struggle will eventually be crowned with success.

XXVIII.

TUBERCULOSIS AMONG CHILDREN IN SWITZERLAND.[1]

By H. CARRIÈRE,
M.D.,
Vice-Director of the Federal Sanitary Department of Switzerland.

The tuberculous death-rate among Swiss children of different ages is indicated in the accompanying tables. The limitations of space preclude the reproduction of extensive statistics, so we may restrict our returns to the years 1901 to 1903, based upon the census of the population taken at the end of the year 1900. These have the advantage of being the expression of exact statistics.[2] It is only since the beginning of 1901 that mortality statistics have reached, so to speak, a state of stable equilibrium by the introduction into all the town wards (*arrondissements d'état civil*), without exception, of a detailed death certificate. Previous to 1901 such returns were only available in towns and wards containing more than 5,000 inhabitants. In the following tables there is shown the infantile mortality from tuberculosis of the lungs and other organs, with the numbers of deaths from tuberculosis, for 10,000 living for each class of age. It will be seen that we have considered as "children" all persons below fourteen years of age, dividing this term into three divisions: first, cases under one year; second, those from one to four years; and, thirdly, all from five to fourteen years.

The figures given in Tables I. and II. show us that, speaking generally, the mortality from tuberculosis of the lungs and of the other organs scarcely varies in children during the three years upon which our statistics are based. In fact, the rate of this mortality has oscillated between 4·8 and 4·9 per 10,000 for pulmonary tuberculosis, and between 11·4 and 12·2 per 10,000 for other tuberculous diseases. The variations are more marked if we consider in detail each of our

[1] We are indebted to Dr. George A. Crace-Calvert for the English translation of Dr. Carrière's article.—Ed.

[2] The restrictions of time and space prevent the inclusion of statistics later than 1903. These will be published elsewhere. The figures, however, here given clearly indicate the relative frequency of tuberculosis among children in Switzerland.

three age divisions. The death-rate is rather high in children under one year, both as regards tuberculosis of the lungs and tuberculosis of other organs. The mortality from tuberculosis falls rapidly in children above one year. In children of less than one year, in the period 1901 to 1903, a rather marked fall in the mortality rate is noticeable both as regards tuberculosis of the lungs and tuberculosis of other organs. In children above one year the fall is much less marked.

TABLE I.—SHOWING DEATH-RATE FROM PULMONARY TUBERCULOSIS AMONG SWISS CHILDREN UNDER FOURTEEN YEARS OF AGE.

Divisions According to Age.	1901.			1902.			1903.		
	Children Living.	Deaths from Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.	Children Living.	Deaths from Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.	Children Living.	Deaths from Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.
Children under 1 year	97,028	119	12·3	96,481	112	11·6	93,824	102	10·9
Children from 1 to 4 years ...	302,592	175	5·8	305,234	126	4·1	308,301	134	4·3
Children from 5 to 14 years ...	652,786	228	3·5	658,486	237	3·6	665,102	276	4·1
Totals from 0 to 14 years ...	1,052,406	522	4·9	1,060,201	475	4·5	1,067,227	512	4·8

TABLE II.—SHOWING DEATH-RATE FROM TUBERCULOUS DISEASES OTHER THAN PULMONARY TUBERCULOSIS AMONG SWISS CHILDREN UNDER FOURTEEN YEARS OF AGE.

Divisions According to Age	1901.			1902.			1903.		
	Children Living.	Deaths from Tuberculous Diseases other than Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.	Children Living.	Deaths from Tuberculous Diseases other than Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.	Children Living.	Deaths from Tuberculous Diseases other than Pulmonary Tuberculosis.	Mortality Rate per 10,000 Children.
Children under 1 year	97,028	326	33·6	96,481	282	29·2	93,824	238	25·4
Children from 1 to 4 years ...	302,592	491	16·2	305,234	463	15·2	308,301	522	16·9
Children from 5 to 14 years ...	652,786	464	7·1	658,486	452	6·8	665,102	486	8·0
Totals from 0 to 14 years ...	1,052,406	1,281	12·2	1,060,201	1,197	11·3	1,067,227	1,246	11 7

By adding together the returns for the three years 1901 to 1903 we obtain the following table, which shows additional age divisions from fifteen to nineteen years, and from twenty to twenty-nine years. The statistics for these later years, indicate the rapid rise in the death-rate from tuberculosis in adolescence and early adult life:

TABLE III.—INDICATING THE TUBERCULOSIS MORTALITY RATE IN SWISS CHILDREN AS COMPARED WITH YOUNG ADULTS.

Ages.	Death-rate from Pulmonary Tuberculosis. Per 10,000 Children Living.	Death-rate from other Forms of Tuberculosis. Per 10,000 Children Living.
Below 1 year	14·4	36·7
1 to 4 years	4·8	16·4
5 „ 14 „	3·7	7·1
15 „ 19 „ ...	17·9	6·7
20 „ 29 „ ...	28·0	5·4

One notes at once the preponderance, in children of early ages, of tuberculosis of other organs than the lungs as compared with pulmonary tuberculosis. It is especially intestinal tuberculosis and tuberculous meningitis which increase the tuberculosis death-rate during the first months of life, as the following table shows, giving, as it does, returns from 1901 to 1903 of the total mortality from tuberculosis of organs other than the lungs.

TABLE IV.—INDICATING THE MORTALITY FROM TUBERCULOSIS OTHER THAN PULMONARY IN SWISS CHILDREN UNDER FOURTEEN YEARS OF AGE.

Form of Tuberculosis.	Under 1 Year.	From 1 to 4 Years.	From 5 to 14 Years.	Total.
Acute miliary tuberculosis	52	71	122	245
Tuberculous peritonitis	22	37	100	159
Intestinal tuberculosis	19	28	57	104
Tuberculosis of the mesentery ...	4	8	12	24
Tuberculous meningitis	395	661	808	1,864
Cerebral tuberculosis	1	7	16	24
Tuberculosis of the urinary passages	—	2	3	5
Tuberculosis of the genital organs	—	1	—	1
Tuberculosis of the bones and joints	24	71	185	280
Tuberculosis of the lymphatic glands	11	13	22	46
Other localities	—	1	1	2

The next table (Table V.), in which is contrasted the death-rate from pulmonary tuberculosis for the years 1888 to 1892 with that of the years 1901 to 1903, shows us that this death-rate has decreased in an obvious manner. (We have not made this comparison for tuberculosis of organs other than the lungs, our statistics being too defective in this particular for the years previous to 1901.)

TABLE V.—INDICATING DEATH-RATE FROM PULMONARY TUBERCULOSIS IN SWISS CHILDREN UNDER FOURTEEN YEARS FOR 1886 TO 1892 AND 1901 TO 1903.

Ages.	Years 1888 to 1892.	Years 1901 to 1903.
	Per 10,000 Children Living.	Per 10,000 Children Living.
Below 1 year	16·70	14·4
1 year	11·10	4·8
2 to 4 years	5·21	
5 „ 14 „	5·13	3·7

If, however, we calculate the proportion of deaths from tuberculosis in relation to the general death-rate for our three classes of ages by adding the figures for the years 1901, 1902, and 1903, we obtain the following table (Table VI.):

TABLE VI.—INDICATING GENERAL MORTALITY RATE FROM PULMONARY AND OTHER FORMS OF TUBERCULOSIS AT AGES UP TO FOURTEEN YEARS.

Ages.	There have been recorded—	
	Deaths from Pulmonary Tuberculosis.	Deaths from other Forms of Tuberculosis.
	Per 1,000 Deaths in General.	Per 1,000 Deaths in General.
Below 1 year	8·6	21·9
1 to 4 years	39·7	135·1
5 „ 14 „	123·0	232·7

These figures show that the different forms of tuberculosis only play a very inconsiderable rôle in the general death-rate of children below one year of age. The mortality rate in early life is dominated by diseases of the gastro-intestinal system. As the death-rate from these diseases diminishes that from tuberculosis increases; and we see that for every 1,000 children who die between five and fourteen years,

about one-eighth are carried off by pulmonary tuberculosis, and nearly a quarter by other forms of tuberculosis. These figures afford material for serious reflection, and are more significant in their unadorned state than long dissertations, showing, as they do, the extreme gravity which invests the prophylaxis of tuberculosis in children.

The Anti-Tuberculosis Movement in Switzerland.

The anti-tuberculosis movement, which had its origin long ago in Switzerland, was first made manifest by the creation, by private initiative, of numerous associations which set themselves to enlighten the public by an active propaganda, and to constitute the different works which we unite under the name of the anti-tuberculosis campaign. These associations exist at the present time in the majority of the Swiss cantons, and are bound together by the Central Swiss Commission for the Anti-tuberculosis Campaign, the president of which is Dr. Schmid, the Director of the Federal Sanitary Department at Berne. The formation of this organization in 1902 gave a powerful impulse to the anti-tuberculosis movement. It goes without saying that this movement has been keenly interested since its foundation in the prevention and arrest of tuberculosis in children. A number of institutions have been established in Switzerland with the special object of looking after the interests of children.

Sanatoria and Anti-Tuberculosis Dispensaries for Tuberculous Children.

We only possess in Switzerland two public sanatoria devoted exclusively to children: these are the sanatorium of Fedey, above Leysin, in the Canton of Vaud, opened in 1902 with thirty-two beds, and conducted by Dr. Exchaquet; and the Berne Sanatorium of Heiligenschwendi, opened in 1903, with forty-two beds, the medical officer of which is Dr. Käser.

We can, however, place in the same category the sanatorium of Erzenberg at Langenbruck, with sixty-eight beds, directed by Dr. E. Burckhardt, which, although a private sanatorium, can almost be reckoned, thanks to its moderate charges, as a public sanatorium; and the home of Dr. Martin, at Pinchat, near Geneva, for the treatment of surgical tuberculosis. We may also mention, although it is attached to a special hospital, the clinic of Dr. Rollier, at Leysin, for the treatment of surgical tuberculosis by altitude and the sun's rays—a treatment which gives remarkable results.

The anti-tuberculosis dispensaries of Geneva, Neuchâtel, Lausanne, and of Berne, also treat, needless to say, many children with tuberculosis, as well as large numbers of predisposed cases.

Special Hospitals and Homes.

Besides the establishments exclusively devoted to the treatment of tuberculosis, we possess in Switzerland a large number of hospitals and homes which are more particularly devoted to, what we may speak of as, the prophylaxis of tuberculosis. The following are the chief establishments:

The Zurich Sanatorium for Scrofulous and Rickety Children, at Ægeri, with forty-three beds;

The Zurich Sanatorium of Schwäbrig, used chiefly as a holiday home;

The Bâle Sanatorium for Children, at Langenbruck, with eighty-four beds;

The Home for Children, at St. Loup, in the Canton of Vaud, with thirty beds;

The establishment for young convalescents, at Vandœuvres, near Geneva, with forty beds;

The Pension of Tournay, near Geneva, for sick and convalescent young girls, with forty beds;

The Infants' Home, at Grand-Saconnex, near Geneva, with thirty beds;

The Hospital for Baths, at Lavey;

The Baths for the Poor, at Schinznach, having twelve to twenty-four beds reserved for children;

The Bathing Sanatorium at Rheinfelden, with twenty-four beds for children;

The Home for Sick Children, "Holeestrasse," at Bâle, with twelve beds; and

Madame Sarasin's Home for Children, at Bâle, with twelve beds.

Besides these different establishments, which have all more or less the character of public institutions, two private establishments may be mentioned—the sanatorium school of Dr. Weber, at Ægeri, with sixty-five to seventy beds, and the sanatorium of Dr. Zellweger, at Trogen, with thirty-nine beds. These receive children suffering from scrofula and rickets, to the exclusion of definite tuberculous cases.

Sea-Bathing Establishments.

Special mention should be made of the work of the committees which annually send scrofulous and rickety children to the seaside. Geneva possesses the most important and the oldest of these committees—"The Geneva Committee for Sea-Bathing." This excellent organization began its work in 1882, and now has at Cette a seaside hospital for children, to which it sends each winter sixty or seventy children. Similar committees exist in the Canton of Tessin, at Bellinzona, at Lugano, at Mendrisio, and at Locarno. The com-

mittee at Lugano sent, between 1873 and 1903, 710 children to the seaside, either at Sestri-Levante or at Venice.

Holiday Homes and other Institutions.

Holiday homes are an essential part of our Swiss work. To-day they exist all over the world; but it is well to remember that it was in Switzerland that they had birth, due to the initiative of an enlightened philanthropist, Rev. Mr. Bion, of Zurich. This work has for its object the sending of the poor sick and feeble children of our towns to the mountains. It has already rendered signal services from the point of view of anti-tuberculosis prophylaxis. The first holiday homes were started in 1876. At the present time they exist in thirty-five localities —in the Cantons of Zurich, Berne, Lucerne, Glaris, Soleure, Bâle-Ville, Schaffhouse, St. Gall, Grisons, Argovie, Vaud, Neuchâtel, and Geneva. The children are generally lodged in the country with peasants or in hired lodgings; certain committees, however, more fortunate than others, possess their own lodgings—their "Ferienheim." The stay of the children at the home varies between three and six weeks. In 1903 the holiday homes received nearly 4,000 children, and the expenses incurred are estimated at about 170,000 francs annually.

We must not fail to mention the stations where "milk cures" are carried on. These do much good with comparatively few resources, especially in localities which do not possess holiday homes. Finally, institutions specially devoted to babies (sucklings), such as crèches, "Gouttes de Lait," and clinics for babies, exist in the majority of the large towns of Switzerland. It is hardly necessary to indicate their importance in the conduct of our anti-tuberculosis campaign. The wisdom of establishing forest schools is now being considered.

All these numerous and varied forms of activity are due to private initiative. It is private initiative also which provides for their administration, and voluntary effort secures means for their support. The State has so far only intervened in a very discreet manner by grants-in-aid, more or less substantial, but varying in conditions.

Switzerland has already made good progress in taking steps to secure prophylaxis against tuberculosis for its children. The work, however, is only in its beginning, and it will be the business of the future to continue and to complete it.[1]

[1] Those desirous of obtaining fuller details concerning the development of the anti-tuberculosis movement in Switzerland should consult—

Schmid, F.: "Die Verbreitung der Tuberkulose in der Schweiz," *Comptes Rendus du Congrès de Berlin pour la Prévention de la Tuberculose*, p. 121. Berlin, 1899.

Carrière, H.: "La Tuberculose et L'Armement Anti-tuberculeux en Suisse," *Tuberculosis*, p. 64. Berlin, 1905.

XXIX.

TUBERCULOSIS AMONG CHILDREN IN NEW ZEALAND.

By J. MALCOLM MASON,
M.D.,
Chief Health Officer for the Dominion of New Zealand.

One disquieting feature which our vital statistics clearly set out is that of the total number of persons who died last year from tuberculosis, 61 per cent. were New Zealand-born. This at first sight seems a complete answer to those who assert that if we could keep out all persons suffering from consumption from oversea our death-rate would fall to a very low figure. It has to be remembered, however, that a very large proportion of our population are not New Zealanders born, and therefore a correction has to be made in order that a true estimate of the vulnerability of the New Zealand-born towards tubercle can be arrived at. When this correction is made it is shown that in comparison with those now living in the Dominion, but who were born elsewhere—the product of the soil, so to speak—has a greater power of resistance.

The census of 1906 showed that the New Zealand-born formed 68 per cent. of the population, so that we have a death-rate from phthisis amongst them of 5·51 per cent., as against a general death-rate of 6·21 per cent.

This is what one might expect; but still, the fact that 61 per cent. of those who were born in the Dominion died of consumption in 1906, is one which has occasioned concern.

Tuberculosis among Infants and Children.

1,865 children under five years died in 1906, which gives a mortality of 22·36 per cent. as compared with the mortality at all ages. It is impossible to say how many of these deaths were due to tubercle, but from the Registrar-General's figures, the following were the principal causes of death in infants under one year :

TABLE INDICATING THE NUMBER AND PRINCIPAL CAUSES OF DEATHS IN NEW ZEALAND FROM 1902 TO 1906 OF INFANTS UNDER ONE YEAR OF AGE.

Principal Causes of Deaths of Infants.	1902.	1903.	1904.	1905.	1906.
Miasmatic diseases	92	191	36	20	43
Diarrhœal diseases	176	122	152	92	65
Premature birth	303	301	291	360	337
Convulsions	82	103	95	96	90
Bronchitis, pneumonia, pleurisy ..	235	241	149	208	170
Enteritis	154	167	231	193	167
Marasmus, etc.	294	270	273	258	267

There is no separate record of the causes of death of those which took place under five years.

It would seem from this official record that there were no deaths caused by tubercle.

It is difficult to be quite sure whether some of the deaths credited to such ailments as marasmus, etc., may not have been dependent on a tuberculous factor.

Climatic and Sociological Considerations.

The climatic and economic condition under which the people in this portion of the British Empire live are assuredly much better than obtain in many others, and did they live as healthily as they could, a great decline in our infant mortality might be expected.[1] It goes without saying that all sorts of climatic conditions are to be found in a country even of the small dimensions of New Zealand, from places on the west coast of the South Island, where the rainfall is best measured in feet, to places like Palmerston South, where in some years very little rain falls at all. Then, again, many of our pioneers, who have gone back to find a livelihood in replacing the primeval forest with grass and sheep and beef, have often to live under conditions which are not the best for their children. Beef, mutton, tinned fish, and milk often form the staple foods, and where the mother cannot suckle there is not infrequently a difficulty in obtaining fresh milk. This will doubtless sound strange with respect to a country which lives largely by exporting butter and cheese; but so it is, and occasionally cases of infantile scurvy are found in outlying country hamlets and houses.

[1] Mason, J. M.: "The Attitude of New Zealand towards Consumption," *British Journal of Tuberculosis*, October, 1907.

Institutional Provision for Children.

So far nothing special has been done in the matter of providing children's hospitals, but there is attached to most of the larger ones a special building or ward, where children are treated. In the country hospitals there is usually no difficulty, because they are almost always situated quite away from the town, and thus the condition sought after by sanitarians in the older countries are much more easily attained here. To my mind tuberculosis is inseparably mixed up with the general infantile death-rate, and thus any measures which are taken to lessen this must operate strongly in favour of any of those who may inherit a lessened power of resistance to tubercle, as well as those actually affected.

Now, while no special effort has been made in the direction of providing homes in the country for children suffering from tubercle, great efforts have been made to save the infants generally.

State Measures.

Last session Parliament passed an improved "Infant Protection Act." Certainly it deals only with those children the care of which devolves upon the State, but its effect will make for the greater safety and well-being of others as well.

In each of the large cities the State has established Maternity Homes, where the wives of workmen and settlers in the country can go to be confined. The patients pay from 30s. per week, and the institutions are largely self-supporting. These hospitals are quite distinct from the maternity homes run by the Salvation Army and other philanthropical organizations, and are intended to be in no sense of the word "charitable institutions." Undoubtedly they have done great good. The mothers receive instruction as to the best care of the infants, and in most instances the matrons are able to persuade the mothers to suckle their offspring. The effect of this upon the health of the children cannot be overestimated.

Care of Milk and other Foods.

Strange it must seem to those resident in the more densely-populated parts of the Empire that there should be a difficulty in securing for the children in our larger towns a pure milk supply. In a pastoral country, such as this, it would be expected that good milk would abound. There is plenty of good milk as there is an excellent supply of the finest beef and mutton, but alas! the consumer oversea not infrequently gets the best.

All animals killed for food in the Dominion have to be passed by a qualified veterinary surgeon, and without doubt finer meat could not be produced.

All butter exported is graded by expert graders, and here again nothing is left to be desired; but when we come to the milk supplied to our own people great, very great, improvement is needed.

For several years I have advocated the setting up of municipal "clearing-houses" for the larger cities. All milk sold within the borough would pass through this one portal, where its purity and nutritive value could be assessed. At this "clearing-house" there would be cool stores, pasteurizing apparatus, and, if need be, the milk could be humanized. The milk would be sent out in glass bottles.

Already several private companies are carrying out this system, but it needs to be more general.

Most of the principal cities have set up committees to consider ways and means whereby this desirable condition of things may be brought about.

A high infantile mortality very often simply spells an impure milk supply.

We have no very definite records here as to the causation of tuberculosis through infected milk; but I consider the striving after a pure milk supply as one of the most important objects which we who wish to fight King Tubercle can busy ourselves with.

Anticipations.

I have said that we have no special hospitals or sanatoria for children suffering from tubercle; but our patients are well cared for, as they are admitted into all hospitals and sanatoria.

We have no general system of medical inspection of school-children, but I am in hope that soon a scheme, which has been outlined, considered, and generally approved by the medical and teaching professions, will take actual form.

With an area equal to England, Scotland, and Wales, and a population of scarcely 1,000,000 people, it is easy to see that to carry out the elaborate system practised in some of the older countries would be impossible from a financial point of view.

Roughly speaking, we have some 127,000 children attending our State schools, and if we assume that about 10 per cent. of them are below par in physical health, this would leave, say, 11,430 children who would require careful medical assessment.

My idea was to enlist the sympathy of our teachers, and ask them to note any child, the subject of definite malnutrition, manifesting marked languor or stupidity, having a persistently open mouth, and who shows any defect in eyesight or hearing, and so on. It is not expected that the teacher should attempt to make any diagnosis; simply place a mark against the child's name and hand the list to the medical inspector when he visits the school.

Such a system would of course fall far behind in its completeness those practised in Britain, America, and the Continent, but it seems to me that it would help greatly in checking the incidence of tuberculosis and other diseases in the early years of life.

Conclusions.

There is not the same necessity in New Zealand as there is in the more densely populated towns of Great Britain and America for special hospitals for tuberculous children. Such children are admitted to all the sanatoria established in this country for the treatment of tuberculosis.

Great efforts are being made to secure a pure milk supply.

Our hospitals are State-supported institutions, and therefore no child need go without proper treatment if such is required.

Every opportunity is taken to point out how disease is spread, and how infection may be guarded against, and I am glad to say the people generally are coming to look upon the officers of the Health Department more in the light of counsellors than as inspectors whose advice and commands are to be evaded.

XXX.

TUBERCULOSIS AMONG MENTALLY DEFECTIVE CHILDREN.

By GEORGE EDWARD SHUTTLEWORTH,

B.A., M.D.,

Consulting Medical Officer, National Association for the Welfare of the Feeble-Minded; Hon. Consulting Physician, late Medical Superintendent, Royal Albert Asylum for Imbeciles, Lancaster.

THE frequent association of tuberculous disease, both parental and personal, with congenital mental defect has long been recognized by those who have made a study of idiocy and imbecility. Ireland,[1] in his classical work, states that "the most important of the influences conducing to idiocy seems to be the tubercular diathesis. A considerable number of idiots have parents affected with phthisis; a large proportion of deaths with idiots and imbeciles are from the same disease. Perhaps two-thirds, or even more, of all idiots are of the scrofulous constitution." Kerlin,[2] many years Superintendent of the large Pennsylvania Institution for Feeble-Minded, traced a phthisical family history in no less than 56 per cent. of 100 of his cases, the family antecedents of which he was able exhaustively to examine through two generations. The late Dr. Langdon-Down, in his "Lettsomian Lectures,"[3] stated that in his experience (largely with mentally deficient children of the better social class) there was a marked history of phthisis in 25 per cent. of the fathers of his cases (or of near paternal relatives), and in 20 per cent. of the mothers. Fletcher Beach and the present writer,[4] in an article on the ætiology of idiocy, give a prominent position amongst causative factors to a phthisical family history, stating that in no less than 28·31 per cent. of the 2,380 cases at the Darenth and Royal Albert Asylums critically examined such a history existed. Tredgold, in his careful analysis of

[1] Ireland: "Mental Affections of Children," p. 18. London. 1900.
[2] Kerlin: Proceedings Association Medical Officers' American Institute. F. M., p. 150.
[3] Langdon-Down: "Mental Affections in Childhood and Youth," p. 64. London.
[4] Beach, F., and Shuttleworth, G. E.: See joint article in Hack Tuke's "Dictionary of Psychological Medicine," vol. ii., p. 660. London. 1892.

the family history of 150 mentally deficient children in London asylums, found that "in every 100 families in which weak-minded children are born, in 34 there exists a marked tendency to consumption or other tuberculous lesions."[1] Lapage,[2] in an analysis of 250 feeble-minded cases in Manchester Special Schools, found that "a family history of tuberculosis existed in 31 cases, and in 13 of these it was the only factor enumerated, only cases of *marked* tuberculous lesion in the parents or their families being taken as evidence." This is equivalent to a percentage of 11·2, and approximates the percentage of phthisical family history given by Martin Barr,[3] of the Pennsylvania Institution for Feeble-minded, in his ætiological tabulation of 3,050 cases at that institution, which amounts to 7·57. In the latter table it would, however, appear that it has been attempted to assign only a single cause to each case; whereas in the other statements cited the tuberculous family history is only one amongst several possible concurrent factors. In Tredgold's statistics only 7·5 per cent. of the cases are attributed to tuberculous family taint alone; in 19·5 per cent. these are complicated with insane inheritance, and in 7 per cent. with other neuropathic inheritance; and it is remarked that the three factors—nervous abnormality, alcoholism, and phthisis—very frequently occur together in the same family. The same remark is applicable to the other English statistics cited. Lapage considers that family tendency to tuberculosis may act as a primary factor in giving rise to a neuropathic diathesis, and so favouring the production of feeble-minded offspring, or as a secondary and additional toxic factor in the presence of other debilitating taints.

In an investigation made by Dr. Ettie Sayer[4] into the family history of 100 consecutive cases of mental deficiency occurring in London special schools, as compared with that of 100 normal children from corresponding ordinary schools, it was found that whereas in the latter series only 2 per cent. had a parent suffering from pulmonary tuberculosis, 13 per cent. of the mentally deficient had one parent phthisical, eight of these having actually died of the disease.

Mortality from Tuberculosis among Mentally Defective Children.

Considering the frequent association of tuberculous family history with manifestations of mental defect in childhood, it would seem only reasonable to expect an abnormally large mortality from tuberculous disease amongst this class.

Resident institutions for mentally defective children have long been

[1] Tredgold: *Archives of Neurology*, vol. ii., p. 338.
[2] Lapage: *Medical Chronicle*, p. 267, 1905.
[3] Barr, M. W.: "Mental Defectives," p. 102. Philadelphia. 1904.
[4] Sayer, E.: L.C.C. Education Committee Medical Officer's Report, p. 43, 1906.

notorious for a high tuberculous death-rate in proportion to the deaths from other causes. As in the analogous case of lunatic asylums, it has been queried how far the abnormal tuberculous mortality is due merely to predisposition inherent in the patients, and how far to the vitally depressing influences of residence in large enclosed buildings favourable to the dissemination and insemination of tuberculous germs. It seems probable that both personal inheritance and institution conditions may fairly be taken into account as concurrent factors, though of recent years great efforts have been made to eliminate as far as possible the latter by improving the sanitary conditions of institutions, by isolating cases known to be tuberculous, and by the adoption, so far as practicable, of open-air treatment.

From a scrutiny of the tables of causes of death amongst the mentally defective inmates of the Royal Albert Asylum, Lancaster,[1] it appears that out of a total of deaths from all causes numbering 145 during the last ten years, 54 at least have been due to various forms of tuberculous disease. In this institution, with an average of 600 patients resident during the last ten years, at least 37·3 per cent. of all the deaths have been due to some specific forms of tubercle; and it is possible that other deaths attributed to meningitis and peritonitis might considerably swell the proportion. The average death-rate from all causes during the last ten years has been 2·35 per cent., and that from clearly defined tuberculous disease about 0·9 per cent. estimated on the average number resident.

Dr. Caldecott has been good enough to furnish a statement that at the Earlswood Asylum, out of 1,000 consecutive deaths, 392—*i.e.*, 39·2 per cent.—were from tubercle in one of its various forms, 305 from pulmonary tuberculosis, 54 from general tuberculosis, 17 from abdominal tubercle, 11 from tuberculous meningitis, and 5 from tuberculous joint disease.

Dr. F. Douglas Turner, in his medical report for 1907 of the Eastern Counties Asylum for Idiots, Imbeciles, and the Feeble-Minded at Colchester, states that from 1867 to 1904 the tuberculous mortality at that institution was as much as 4·6 per cent. on the average number resident (the general death-rate having averaged 7·7 per cent. during the forty-seven years from 1859 to 1905). During the last three years, owing to improved sanitary conditions under the watchful eye of Dr. Turner, not only has there been a phenomenal reduction of the general death-rate to one-sixth of its former average, but the tuberculous mortality has declined to the low percentage of 0·4. The prompt detection and segregation of incipient cases and the employment of open-air treatment, so far as the structural arrangements permit, have doubtless conduced to this remark-

[1] See successive Annual Reports of Dr. Telford Smith and Dr. Archibald Douglas since 1898.

able result, which should encourage authorities of other similar institutions to adopt like means for repressing the abnormal prevalence of tuberculous disease amongst their inmates.

In the large Massachusetts School for the Feeble-minded, Dr. Fernald, the superintendent, states that with an average population during the last ten years of 796, there have been 218 deaths, 56 of which have been from tuberculous disease, a percentage of 25·7 to the total mortality, and 0·7 on the average number resident.

At the Pennsylvania Institution for Feeble-minded, Dr. Martin Barr, the superintendent, shows, with an average population during the last ten years of 1,088, tuberculous disease was an ascertained factor in the causation of 78 out of an aggregate of 242 deaths, equivalent to 32 per cent. of the total mortality, and 0·7 on the average number resident.

Whilst the statistics of the American institutions give a somewhat lower proportional percentage of tuberculous deaths than do the English institutions of similar character, it may be said that, collectively, the experience is that in large institutions, at any rate, more than one-third of the mortality is due to this kind of disease.

No figures exist with regard to the mortality from tuberculosis of mentally defective children outside institutions; but it is known that in one well-marked type—the so-called "Mongolian"—which is estimated to include some 10 per cent. of all cases of mental defect, the development of tubercle is exceedingly common. The late Dr. Langdon-Down laid stress upon the great importance of mentally defective children residing on a dry soil, stating that whereas in an institution on a clay site the tuberculous death-rate amounted to 39·8 per cent. of the general mortality, that on a gravel soil showed a similar percentage of only 12 per cent.[1] There can be no doubt that outdoor life is of the utmost importance to the physical as well as mental amelioration of mentally defective children, and for this a dry soil offers superior facilities.

The whole question is one of national importance, and deserves thorough investigation.

[1] Langdon-Down: "Mental Affections of Childhood and Youth," p. 113.

XXXI.

EXERCISE IN THE MANAGEMENT OF TUBERCULOUS AND TUBERCULOUSLY PREDISPOSED CHILDREN.

By HARRY CAMPBELL,
M.D., F.R.C.P.,
Physician to the West End Hospital for Nervous Diseases, London; author of "Respiratory Exercises in the Treatment of Disease."

THE better developed the lungs the greater will be their resistance to disease, tuberculous or other, and it is therefore very important to secure proper development of these organs in phthisically disposed children. This can only be done by adequate muscular exercise.

Among children of this class the lungs are often unduly small, the chest being of the "phthinoid" type, *i.e.*, actually smaller than it should be at the end of a complete expiration: the clavicles, scapulæ, and sternum are low, the ribs unduly oblique, the sagittal diameter of the thorax is small, the costal arch very acute, and the diaphragm high, while the heart is correspondingly high and superficial.

Another type of chest met with in the phthisically disposed is the so-called "flat chest." In it the thorax appears when viewed anteriorly, to be flattened in its upper part, though, as a matter of fact, there is no real flattening from before backwards. The flat chest results in large measure from muscular weakness, in consequence of which the child stoops, and the scapulæ tend to glide forwards towards the lateral aspects of the chest, carrying the humeri and outer ends of the clavicles forwards (= round shoulders). This type of chest is thus, in a sense, a reversion towards the anthropoid type, in which the upper extremities, adapted as they are for progression, are laterally disposed.

There is little difficulty in correcting this deformity, providing the lungs be free from actual disease. When these organs are extensively affected with tubercle the deformity is manifestly past correction.

Impediments to Normal Breathing.

In order that the lungs may develop properly, care must be taken not to allow the free play of the ribs to be interfered with by unsuitable clothing, and to correct any impediment to nasal breathing that may exist.

Unsuitable Clothing.—The two objects to be aimed at in clothing the chest are lightness and looseness. There should be a minimum of weight on the shoulders and chest, and sufficient looseness to admit of the fullest possible chest expansion—that is to say, the dress measurements should be taken, not while the chest is in a state of mean expansion, but while in extreme inspiration. A special evil to be guarded against is the accurate fitting of the garments to a misshapen chest. Suppose, for instance, that a coat or bodice is accurately fitted to a stooping figure, it is clear that this must greatly hamper any attempt to straighten the body and expand the chest. The nether garments, both in the boy and the girl, should, as far as possible, be supported from the hips rather than the shoulders. The evils attaching to the use of the roller-bandage in the case of the infant and of tight-fitting corsets are sufficiently obvious.

Nasal Obstruction.—It is important that the child should be capable of normal nasal breathing during night as well as day. The function of the nasal passages being to prepare the inspired air for entrance into the lungs, it is not surprising that nasal obstruction should promote pulmonary disease, and, as a matter of fact, it is a potent cause of bronchitis and phthisis in children. Much the most common cause of nasal obstruction in early life is "adenoid" disease. When present, we treat this affection by a combination of surgical measures and breathing exercises. Much more sensible, however, is it to prevent its occurrence; and this, as I have elsewhere insisted, can be done by recourse to a rational system of dietetics—by the avoidance of semi-liquid, pultaceous, or spongy forms of farinaceous foods, and substituting such articles as bread-crust and hard biscuits, which compel adequate mastication and insalivation, thus avoiding the double evil of defective naso-maxillary development, and gastro-intestinal indigestion with its attendant toxæmia. This latter is, I am convinced, a potent cause of tuberculosis in children. The so-called "delicate" or tuberculously-disposed child owes his delicacy chiefly to this indigestive toxæmia; and much the most fruitful source of indigestion in children is the flooding of the stomach and bowel with crude unmasticated starch.

The Kind of Muscular Activity suitable for Children.

The need for muscular activity during the years of development is shown by the instinctive promptings observed in all healthy and vigorous young animals. Children, like the rest, indulge in exercise

from sheer pleasure in it, and, indeed, begin to exercise their limbs before they are yet born. This prompting takes the form of sudden spurts of activity, such as running and jumping, dancing and climbing —modes of activity which find a place in most of the outdoor games of youth. None of these actions, be it noted, are continued for any length of time, but are taken up spasmodically in short, sharp bouts, separated by intervals of comparative inaction. The child is much less capable than the adult of steady, long-continued exertion.

Guided by these considerations, we recommend for young people short, brisk exercises, such as skipping, dancing, running, and tennis. None can compare with these for securing normal development—above all, development of the thorax. Exercises demanding endurance, such as long-distance running, we discountenance in the very young.

Effect of Exercise on the Respiratory Movements.

Muscular exercise raises the percentage of CO_2 in the blood, and in this way influences the respiratory centres, and so the respiratory movements. These are increased in frequency and amplitude, while inspirations tend to be more complete than expirations. Especially is this the case in pronounced breathlessness. It may then be observed that, while inspirations are deep, expirations are comparatively incomplete, so that the mean size of the thorax is increased, the enlargement being in proportion to the degree of breathlessness.

Such being the case, we have in exercises which cause breathlessness a ready means of permanently increasing thoracic capacity, the predominant action of the inspiratory muscles causing a permanent shortening of them, thus fixing the chest in an expanded position. Hence the best way to bring about a permanent enlargement of the thorax is to prescribe exercises which induce breathlessness, such as running, skipping, and dancing, rather than gymnastics and dumb-bell and kindred exercises, which cause comparatively little breathlessness, and increase the girth of the thorax mainly by developing the muscles enveloping it. Gymnastics, moreover, tend to produce thoracic rigidity, while our object is to secure the fullest mobility of the thoracic cage. I am not, however, denying that in some cases specially-devised exercises may be required in order to correct deformity or to strengthen particular groups of muscles. These are referred to later.

The fact that breathlessness tends to cause thoracic expansion has a further important practical application. It follows from it that children suffering from pulmonary tuberculosis seldom stand in need of special respiratory exercises, inasmuch as the dyspnœa, which is so readily induced in them, provides all the pulmonary expansion which is desirable. It cannot too emphatically be insisted on that the dyspnœa produced by pulmonary disease tends to excite the inspiratory

muscles more than the expiratory muscles, and thus to increase the mean size of the chest; and, further, that this increase is of a compensatory nature, tending as it does to increase the aerating surface of the lungs, as well as to facilitate the work of the right heart. In all advanced cases of phthisis the chest will be found to be expanded wellnigh to its maximum. In the earlier stages, before the onset of decided dyspnœa, this is not the case; but if it be desirable to expand the lungs in these early cases, this can quite easily be done by almost any kind of exercise, owing to the readiness with which dyspnœa can be induced.

The Influence on the Lungs of Talking, Shouting, Crying, and Singing.

The influence of talking, shouting, crying, and singing in furthering pulmonary development must not be lost sight of. The instinctive prompting to them displayed by the child should not be unduly suppressed. Crying in the infant is in large measure physiological, and favourable to pulmonary expansion. It has even been suggested that many evils which manifest themselves in later life, such as chlorosis, contracted chest, and the phthisical habit, may take their origin in the practice of mothers "stopping their infants from screaming by soothing them to sleep in their arms, or by stupefying rocking in the cradle' (Rosbach).

The instinct of children to chatter and to sing in the early morning should, as far as practicable, be allowed full vent. The shouting which young people indulge in while at play is manifestly physiological, and favourable to the normal development alike of the nose, the throat, and the lungs.

From the medical standpoint singing is a most valuable exercise. Its beneficial effect in developing the chest and warding off lung disease is shown by the remarkable pulmonary development and freedom from pulmonary disease observed among professional singers. Such therapeutic importance, indeed, do I attach to singing that I recommend it whenever practicable. It is especially useful in defective chest development. Provided the patient can sing without effort, and there be no marked tendency to hæmoptysis, I know of no pulmonary condition in which it is contra-indicated. We should, of course, proceed cautiously if the tendency to hæmoptysis is great; but a small amount of hæmoptysis need not bar the patient from singing, for it is a remarkable fact that pulmonary hæmorrhage shows little tendency to occur after exertion, being, on the contrary, most frequent at night and in the early hours of the morning.

Respiratory Exercises.

It is of the utmost importance that the air which the child breathes while doing his respiratory exercises should be as pure as possible, more especially since in the deep breaths which they often demand impurities may be inhaled. Nature makes every effort to protect the lungs from the ingress of nocuous matters—chemical, mechanical, and microbic. Thus normal breathing takes place through the nose, whereby the air is not only warmed and moistened, but filtered. Then, again, the air inhaled with every inspiration—*i.e.*, the tidal current—does not pass further than the trachea and large bronchi, gaseous diffusion taking place between the new air thus introduced and the comparatively stagnant air in the smaller bronchi and alveoli; and the tidal current thus being confined to the trachea and larger bronchi, solid particles, uninfluenced by the law of gaseous diffusion, are in large measure prevented from passing into the smaller air passages. Hence, those which do not pass out with the expiratory current are deposited in the mucous membrane of the larger passages, and becoming entangled in mucus, the secretion of which they excite, are for the most part removed by expectoration. This removal is further favoured by the outwardly lashing cilia, which, lining as they do the entire bronchial tree down to the ultimate bronchioles, act as highly efficient scavengers.

I have said that the air inhaled should be as pure as possible. It is, unfortunately, not always easy to secure pure air, especially in the dwellings of large towns. The nursery should contain a minimum of furniture, and should be well ventilated. In many cases the exercises may be done with advantage before the open window. When possible they should be conducted in the open.

If the patient has a delicate chest it may be advisable to dry, purify, and medicate the air. Medicated substances, such as eucalyptol, menthol, pinol, guaiacol, sanitas oil, terebene, and camphor, are all found freely volatile, and thus probably gain access to the remotest vesicles, unlike such comparatively stable substances as creosote and carbolic acid, which are much less likely to travel beyond the large bronchi. There is another advantage in employing volatile medicaments—viz., their ready absorption by the respiratory tract. Such a substance as turpentine is highly penetrating, so much so that a small quantity of wet paint in a house will speedily cause the urine of its inmates to smell of violets.

In order to strengthen weak respiratory muscles, it may be necessary to resort to dumb-bell and similar exercises. The dumb-bells should not weigh more than $\frac{1}{2}$ pound. The diaphragm may be strengthened by being made to contract against resistance in the shape

of pressure applied to the anterior abdominal wall. This may be obtained by a sheet of lead of varying degrees of thickness, fitted to the belly in the horizontal position of the body.

Before resorting to special respiratory exercises the child must be taught to obtain complete control over his respiratory movements. He should first learn to dissociate costal and abdominal breathing, since each produces its own peculiar effects. Thus, in deep abdominal inspirations, the bases of the lungs are expanded more than the apices, while intra-abdominal tension is increased, and the blood squeezed out of the abdominal veins into the right heart. At the same time the abdomino-pelvic viscera are compressed and commoted, their functions being thereby altered, while lymph is pumped from the peritoneum into the pleuræ. On the other hand, in a full costal inspiration the upper regions of the lungs are more fully expanded than by any other means, while intra-abdominal tension is diminished, and the flow of blood from the digestive viscera into the splanchnic veins, and from the kidneys, pelvic viscera, and lower extremities into the inferior vena cava, accelerated.

Diaphragmatic breathing is best learned in the supine position. All impediments to the free play of the diaphragm being removed, the individual should concentrate his attention on the abdomen, seeking to protrude it to the utmost with every inspiration, and to keep the bony thorax fixed. After a little practice complete control over the diaphragm in the upright posture will be acquired. In diaphragmatic breathing the lower ribs tend to be raised, and it requires some practice before one can contract the diaphragm without raising the ribs—before, *i.e.*, pure "abdominal," as distinguished from diaphragmatic, breathing can be acquired.

Next as to the purely costal type of breathing. This may be practised both in the horizontal and the upright posture, the attention being concentrated on the ribs. These should be raised to the utmost, while every effort is made to keep the anterior abdominal wall stationary. Lower costal breathing may then be practised. In order to acquire it, let the palm of each hand be placed on the corresponding half of the lower chest; and while care is taken not to raise the clavicles nor protrude the belly, an attempt should be made to separate the hands as far as possible by expanding the lower chest; the lower ribs should then be depressed, so as to allow the hands to come as close together as possible. It will be found difficult to do this without resorting to some degree of abdominal breathing.

It is useful to be able to dissociate the movements of the two sides of the chest, for we are thus enabled to exercise one lung more than the other, and also to increase the mobility of the chest, notably of the chondro-sternal joints. Unilateral breathing may be facilitated in the

following way: One hand is placed in the corresponding axilla, and firm pressure is made on the same side of the chest, so as to check its movements as far as possible. The opposite arm is then gradually raised from the side until the wrist rests on the head; and while this is being done, an attempt is made to expand to the utmost the corresponding side of the thorax, the body and head being at the same time inclined to the opposite side.[1]

Evil Effects of Muscular Fatigue.

While properly supervised exercise is of the greatest advantage to the delicate child, muscular exhaustion must be carefully guarded against. Excessive exercise produces definite effects upon the blood and tissues, diminishing the resistance to the tubercle bacillus, pneumococcus, and other germs, more especially if, during the period of muscular exhaustion, the body is chilled, as by lying on the damp ground, or sitting in a draught while the skin is bathed in perspiration.

The Therapeutic Advantages of Rest.

The good which the delicate child derives from properly-regulated exercise must not blind us to the benefit which may be got from rest. The child should spend certain portions of the day resting in the horizontal position. We are apt to forget that this is the normal position of rest. It is only since the introduction of chairs and other artificial props that sitting has become so common. In earlier times such rest as man took during the day consisted in stretching himself out on Mother Earth. It is evident that the body can rest more completely in this than in any other position, seeing that in it there is a minimum strain on muscles, cardio-vascular system, and viscera. In regard to the latter, the fact must not be overlooked that the maintenance of the ascending colon for too long a period in the vertical position favours fæcal accumulation in the cæcum, thus predisposing to constipation as well as to appendicitis.

The best time for resting is immediately after a meal.

[1] For a description of special exercises the reader is referred to "Respiratory Exercises in the Treatment of Disease," by Harry Campbell, p. 151 *et seq.* London: Baillière, Tindall and Cox.

XXXII.

ALPINE CLIMATES FOR TUBERCULOUS AND TUBERCULOUSLY DISPOSED CHILDREN.

By WILLIAM R. HUGGARD,
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For many years the high mountains have been gaining in favour as a recruiting ground for delicate children and for children with signs of early tuberculosis of glands, lungs, or bones. In this respect Davos, St. Moritz, and Arosa have a good record.

The Physiology of Alpine Climates.

Until lately the strikingly beneficial influence of the climate on children was largely a matter of clinical observation or experience. But during the last few years careful investigations have placed mountain climates in a unique position in regard to our knowledge of their physiological action. These researches have made clear why high mountain climates are especially invigorating and health-giving for young people. Clinical observation shows that children coming from the lowlands almost immediately improve in health in the mountains. Adults sometimes do not respond to the demands made by the cold, rarefied air, but children hardly ever fail to thrive. The only exception to this rule will be pointed out presently.

Since Paul Bert's great work, "La Pression Barométrique," was published in 1878, the problems of the physiological action of high altitudes have been studied by a succession of distinguished workers. The most important and most complete investigations of this kind were carried out in 1900 and 1901 by half a dozen German physiologists working together. They made preliminary studies and experiments in Berlin (56 metres, or about 184 feet above sea-level), and continued their researches at various elevations up to the summit of Monte Rosa (4,560 metres, or 14,961 feet). The chief experiments were made at Brienz (500 metres, or 1,640 feet above sea-level) and at the Rothorn (2,130 metres, or 6,920 feet). Brienz and Rothorn had the advantage

from an experimental point of view of being connected by rail, thus enabling the observers to pass from one station to the other without fatigue.

Amongst the physiologists engaged in the research were N. Zuntz and A. Loewy. This circumstance may be taken as a guarantee for the high quality of the work. The record of the investigation is given with lucidity and with great fulness in a large volume.[1]

The space now available will allow of only a very meagre account being given of some of the chief results obtained. The influence of high altitude on the blood, on the blood-forming organs, and on metabolism yielded studies of great value.

The observations on the blood were especially interesting. The blood of the members of the expedition did not show any constant change in the number of red corpuscles at different elevations. Nor was any constant change in the specific gravity of the blood or of the blood serum to be detected. There was thus no concentration of the blood at the higher altitudes.

Observations were made also on dogs. Four of these dogs were young fox-terriers of the same litter. The other dogs were full grown. Some of the dogs were kept in Berne, and some were transferred to the Rothorn. All the dogs at the higher elevation showed an increase in the number of red corpuscles, but in the case of the older animals the increase was very small. The hæmoglobin in the blood of a fox-terrier at the lower altitude amounted to 10·78 grammes per kilo of body weight; at the higher altitude to 12·99 grammes; that is, 20·5 per cent. more at the higher station. This result harmonizes with the results obtained by nearly all other observers.

Equally interesting and important were the facts disclosed by examination of the bone-marrow when the animals were killed. The bone-marrow of the young fox-terriers kept at the Rothorn (7,060 feet) was red, showing the persistence of the active blood-making function up to the time of death. The bone-marrow of the dogs of the same litter that had been kept at Berne (1,312 feet) was yellow, showing the fatty changes indicating that the blood-making function had ceased or greatly diminished.

Not less significant than the increased blood-formation at the higher altitude was the observation made on the comparative growth of the young animals at the different levels. In the growing dogs increase of weight took place more rapidly, and went on to a greater extent at the higher than at the lower station. In both cases the animals were allowed to run about and to eat as much as they liked.

[1] "Höhenklima und Bergwanderungen in ihrer Wirkung auf den Mensohen." Von N. Zuntz, A. Loewy, F. Müller und W. Caspari. Berlin: Deutsches Verlagshaus Bong and Co. 1906.

The experiments on metabolism yielded extremely instructive results. The processes of combustion or oxidation were as a rule found to be increased both in the resting man and in the man at work. The degree in which these oxidation processes were increased at high elevations was different in different persons; in some being slight or even absent at the greatest altitudes, such as 4,500 metres (14,764 feet); in others being well marked at comparatively low elevations, such as 1,600 metres (5,249 feet).

After the return from medium altitudes to the plains the combustion processes sank below the normal for a considerable time. In other words, the body gains on returning to the lowlands.

The most remarkable fact established, however, was the seemingly anomalous behaviour of nitrogenous metabolism. Side by side with the increased oxidation of fats and carbohydrates in the body was the tendency to diminished oxidation of nitrogenous substances. In other words, some storing of proteid in the tissues occurred. The authors say: "We see, therefore, that the mountains exercise a quite characteristic influence on the balance of the most important organic material in the organism; and that in the mountains up to certain heights, which vary for individuals, the adult reacts similarly to the growing organism in ordinary circumstances. In this fact the saying about the rejuvenating action of a stay in the mountains finds its exact expression."

Clinical Consideration.

The application of the foregoing investigations in the case of children is obvious. We have, so far as I am aware, no other means comparable with a mountain climate to stimulate the blood-making and the nutritive functions of children and young people. Where tuberculosis is present the improvement of the blood and of the nutrition is our chief aim. In middle or advanced life there are various contra-indications that may render the high mountains unsuitable; but in early life intolerance of high altitudes is extremely rare. The condition most likely to render children unsuitable for the high mountains is an excessively irritable state of the nervous system.

The question of the possibility of infection requires a moment's consideration. Wild statements are sometimes heard as to the likelihood of infection at Davos. But I doubt whether, as a matter of fact, any other health resort could be found in which such a risk is less than in Davos. Davos stands alone amongst health resorts in its stringent precautions against infection. In a great many health resorts the statement is made that invalids suffering from tuberculosis are not received. The usual meaning of this is merely that no precautions are

taken. At Davos any risk of infection with tubercle must certainly be regarded as infinitesimal.

The Germans have utilized more fully than have the English the advantages to be gained by young people from residence in the mountains. Amongst the sanatoria that they have established in Davos is a school-sanatorium for boys,[1] where delicate lads can get a first-class education, and at the same time benefit by the invigorating air. It is a pity that there is as yet no such institution for English boys. In this respect St. Moritz is more fortunate in having a small but good school for English lads.[2]

FIG. 18.—DAVOS IN WINTER.

Alpine Health Stations.

Of the high Alpine resorts, Davos, St. Moritz, and Arosa are the best known and the most completely equipped. Other high stations are Leysin (4,757 feet above sea-level), Château d'Oex (3,261 feet), Grindelwald (3,468 feet), Les Avants (3,232 feet), Caux (3,690 feet), Montana (4,960 feet), and Adelboden (4,450 feet). At Zuoz (5,660 feet), in the Upper Engadine, there is an international school. Each place has its own characteristic features, which render it more suitable or more attractive for certain cases.[3]

[1] Schulsanatorium Fridericianum, Davos-Platz.
[2] H. Walker, M.A., Villa Oxonia, St. Moritz.
[3] For details consult: Huggard, W. R.: "A Handbook of Climatic Treatment, including Balneology." London, 1906. Also "Davos as a Health Resort." By numerous contributors. Davos, 1906.

FIG. 19.—AROSA IN WINTER.

For the invalid who wishes to make the most of his time, Davos (Fig. 18), Arosa (Fig. 19), or Leysin will be selected. These resorts also are most suitable for those who have not learnt to lead the kind of life required by their ailment. Of these three places Davos offers the greatest opportunity both for education and for amusement. St. Moritz answers well for delicate boys and girls without actual disease. Château d'Oex and Grindelwald are adapted for old invalids who know the length of their tether, and for young people under the charge of a friend or relation of experience. Caux is also well adapted for former invalids. Les Avants is suited for the least vigorous people for whom a mountain climate seems desirable.

XXXIII.

AMERICAN CLIMATIC STATIONS FOR TUBERCULOUS CHILDREN.

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The American health stations for tuberculous children are most advantageously grouped according to temperature, humidity, and altitude, and for our present purpose we may classify the various resorts after this manner.

Cool and very Moist Health Stations.

Only those need here be considered where the summer months average between 60° and 68°. Cooler resorts are not to be recommended, because they afford a rather large proportion of raw days. In this class we may place the seaside stations of the Maritime Provinces and Maine, which have a generally pleasant, though somewhat damp and foggy, summer and early autumn. Accommodation is not often good in the resorts of New Brunswick and Nova Scotia, but usually excellent quarters may be obtained at many of the resorts on the Maine coast. From November until May this region is not suited to the treatment of tuberculous children, for during the greater portion of this period the weather is excessively wet and stormy, and the late spring is marred by frequent sea-fogs and penetrating north-east winds.

The Pacific coast from San Francisco to British Columbia has a cool and very moist climate, but the winter is relatively mild, resembling that of Western Europe in temperature as well as many of its most disagreeable features. The summer is usually too chilly, windy, and foggy on the coast itself, but delightful at semi-inland stations, such as Portland, Seattle, Victoria, and Vancouver, where, however, the climate at that season is only moderately moist, with little rain and some dust.

Cool and Moderately Moist Health Stations.

This group contains so many resorts that it is necessary to subdivide. In the interior of Canada, away from the Great Lakes, also in northern Minnesota and north Dakota, we have a low-level climate with a pleasant summer, July averaging between 62° and 68° F., with warm days and cool nights. The winter, however, is intensely cold, January averaging 12° at Montreal and 4° below zero at Winnipeg, and is, therefore, too cold for young children. In the Lake region, north of the 43rd parallel, the summer is similar and the winter about 10° warmer; but the latter is so cloudy and stormy as to be intensely disagreeable. The spring is likewise decidedly raw, resembling that of the extreme North-east.

In northern Maine, the White and Green Mountains, the Adirondacks and Catskills, the Berkshire and Litchfield Hills, and Sullivan county, N.Y., we find a similar summer climate at elevations from 800 to 2,500 feet, and an average January temperature, rising from 12° to 22° as we go southward. Throughout this region the period from July to October is fine, but May and June are rendered disagreeable by biting insects in the forest districts. The winter is steady, with a constant snow-covering; a little too cold for very young children north of the 43rd parallel, mild enough southward for all ages above infancy. April is the worst month, owing to the sudden melting of the accumulated snows of winter. Southward March sometimes suffers from the same defect in particularly mild seasons, but northward this month can still be depended upon to furnish true winter weather.

Cool and Dry Health Stations.

All the Canadian Rocky Mountain stations, as well as those above 3,000 feet in Montana, 4,000 to 5,000 feet in Wyoming, and 6,000 to 7,000 feet in Colorado, come under this head. At all these resorts only about 50 per cent. of humidity is registered during the summer, but frequent showers tend to lay the dust. The winter is also dry in Colorado and Wyoming, with little snow and hardly any rain; northward it grows moister and rather cold for young subjects. The autumn is fine everywhere, and the spring only moderately subject to rain and snow; there is no slushy period of snow-melting as in the East. Unfortunately, this region is not yet fully developed, and good accommodation is obtainable at only a few resorts. Banff, in Alberta, is a little too cool for young children, even in summer. Helena is perhaps the best resort in this belt, but is rather cold in winter. The Yellowstone Park is open in summer only, and this resort, as well as Cheyenne, is over 6,000 feet high, and therefore near the upper limit of elevation suitable to the treatment of tuberculosis. The cool stations of Colorado are all too high.

Cool Temperate and very Moist Health Stations.

All the resorts in this group have some hot weather, July averaging between 68° and 74°. They include the Atlantic coast and islands, from Portland, Me., to Cape May, N.J. Exposed localities, such as Cape Ann, Cape Cod, Nantucket, Martha's Vineyard, and Block Island, are near the border line, having no very hot weather even in July, but a good deal of fog with a very high humidity, a pleasant autumn, a partly open and very stormy winter, and a somewhat raw and windy spring. These stations are suitable only from June to October. Less exposed stations suffer more from heat and sultriness, but are far better in late spring, and especially in winter, when our young patients can obtain the benefit of a large proportion of sunshine. Long Island and the coasts of Connecticut and New Jersey may be grouped here; they afford a fairly pleasant though not really mild winter climate, a charming autumn, and a tolerable spring, but are a trifle too warm and enervating in midsummer for older children who can indulge in outdoor exercise. Tuberculosis of the lower extremities always calls for a less strenuous regimen, including a higher temperature.

Cool Temperate and Moderately Moist Health Stations.

Here, again, we must subdivide according to the winter temperature. The depression occupied by Lakes Champlain and George has a rather warm summer, but a winter not much milder than in the mountains on either side, and therefore too cold for young children. The valleys of the Hudson and Lower Connecticut are not so cold in winter, but the ground is still covered with snow for two or three months; the summer is too warm for our purposes. In the lowlands of Pennsylvania and New Jersey the winter becomes unsteady, with frequently alternating frost and thaw, rain and snow; the summer becomes unpleasantly hot. Here only the autumn and late spring can be recommended for the treatment of tuberculosis. The same remarks apply to the elevated sites south of New York as far as West Virginia. The climate of Hot Springs, Va., at 2,200 feet, does not differ greatly from that in the middle Hudson River Valley. The above statements apply even more to the more southerly parts of the Lake region, as well as to the remainder of the country lying north of the Ohio and lower Missouri, also Kansas, Nebraska, and South Dakota. Resorts for the treatment of tuberculosis hardly exist in this region, and quite justly so in view of the facts mentioned. One small section, however, must be regarded more favourably—namely, the mountain region of North Carolina and Tennessee, at elevations of 1,500 to 3,000 feet, where Asheville is the representative station. Here we have a moderately cold winter, averaging about 36° in January, with a good deal of rain, but not much

snow, a very agreeable spring and autumn, and a summer averaging 72° in July, a little too warm, save for feeble subjects or visitors from the far South.

Cool Temperate and Dry Health Stations.

First among these are the lower levels of Colorado, from 4,000 to 6,000 or 7,000 feet, Colorado Springs (and vicinity) and Denver being the most frequented stations. Here the winter averages but little below the freezing-point, and is both sunny and dry. There is some rain and snow in spring; the summer heat, often considerable in the afternoon, is tempered by a very low humidity and occasional showers, with cool nights; the autumn is fine and bracing. This region is particularly suited to the permanent residence of tuberculous children who have not got on well in the East or South.

The climate of the higher stations of New Mexico and Arizona is very similar, but less extreme. We may mention Santa Fe, Las Vegas, Silver City, and Albuquerque in the former territory; Prescott, Flagstaff, and Grand Cañon station in the latter. At all these ample showers and cool nights render the midsummer months most healthful; the winter averages near to or somewhat above the freezing-point, and is exceedingly dry and sunny; the spring is a little too dry, and very subject to dust storms.

In Utah, Nevada, Idaho, and eastern Washington the summer becomes unpleasantly dry and dusty, and the winter has more cloudiness and precipitation. The temperatures are similar to those of Colorado, but steadier, the variability from day to day being only two-thirds as great as on the eastern slope of the mountains. Still, the other points just mentioned render the western slope somewhat inferior. Furthermore, good accommodation is hardly obtainable except at Salt Lake City and Spokane, the latter being probably the best year-round station in this region.

Middle Temperate and Moist Health Stations.

We may designate as middle temperate climates such as still have a well-defined but rarely severe winter, in which vegetation is suspended for more than three months, and a summer whose period of unpleasant warmth is equally long. Of the moister climates of this group we may note the very extreme one of the lowlands of Virginia, Kentucky, and Tennessee, also Arkansas, Oklahoma, and southern Missouri. Throughout this belt the winter is still bracing, with plenty of hard frost and some snow. March and April bring fine but changeable weather; then comes intense heat from the middle of May until late in September, followed by charming Indian summer conditions in October and November. This section is fairly good for tuberculous children save

during the four warmest months, but the temperature is too high for the best results except in the unpleasantly changeable winter. The coast of Virginia, especially near Norfolk, is, however, not without value; and the foothills on both sides of the Alleghanies deserve more trial than they have had. Farther west the meteorological irregularities are rather harmful, and less erratic climates are to be preferred when possible.

Middle Temperate and Dry Health Stations.

These are to be found only at a few moderately elevated points in far western Texas and adjacent New Mexico. They have no special value for our purpose, and need not detain us further.

Warm Temperate and Moist Health Stations.

The warm temperate climates have often been miscalled subtropical, whereas their winter still averages from 18° to 25° below that of the tropics, and is, in fact, quite bracing, closely imitating a rather changeable New England April. Our south-eastern states, from North Carolina to eastern Texas, but excluding Florida, present this climate in a somewhat unfavourable form. For example, at Montgomery, Alabama, where January has exactly the average temperature of April at New York City, the thermometer has fallen to 5° below zero, and may be expected to fall below 20° nearly every winter. Such a climate is of little value in the treatment of tuberculosis, especially as the entire period from April to October is very warm, moist, and unwholesome. Along the eastern edge of this region the extremes are somewhat less marked, and such stations as Charleston, Aiken, S.C., and Macon and Thomasville, Ga., may benefit very delicate or young children during March and April.

Warm Temperate and Dry Health Stations.

These are abundant from western Texas to central California. They have a much steadier winter than the South-east, with plenty of sunshine, so that the climate is in every way suited to the less robust and very young tuberculous subject from November until April. In addition, there is the great advantage of an easy transfer to the cooler climate of Colorado or the south-western high elevations for the warmer months. Among these mild winter stations we may mention El Paso, Texas, and Phœnix and Tucson, Arizona. The great valley of California is much moister in winter, but is, nevertheless, far superior to the South-east at such stations as Fresno and Sacramento. Still better, because drier, is the climate of the south Californian hills, as at Redlands, with the additional merit of only moderate summer heat, which, however, it is still best to avoid by a trip to the cooler coast or high elevations.

Very Temperate and Moist Health Stations.

These abound between San Francisco and Santa Barbara, and are at their best from November until April, when the average temperature ranges between 50° and 58°, with abundant sunshine and moderate rains. The summer, agreeably cool, but very damp, at Santa Barbara, becomes increasingly and disagreeably raw, moist, and foggy northwards, the mean temperature of July falling in the same direction from 66° to 58°. Among intermediate stations we may mention Santa Cruz, Monterey, and San Luis Obispo.

Warm and Moist Health Stations.

Those of the South-East, including Florida and the coast of the Gulf of Mexico, are utterly unsuited to the treatment of tuberculosis, for the only months that are sufficiently cool are excessively changeable, June heat alternating with March frosts. In the extreme South-West, on the other hand, very delicate or very young patients may derive benefit from the even, but not enervating, winter and spring of the region near Los Angeles and San Diego, Cal. In this section the summer is late, lasting from July until October, and is too warm only inland. On the coast itself tuberculous subjects who cannot exercise freely may remain throughout the year, but the hardier types of patients should seek cooler and drier regions for the summer, for the warm dampness of such places as San Diego is, in the long-run, rather enervating.

Warm and Dry Health Stations.

The resorts of the far South-West, such as Yuma, Ariz., and Indio, Cal., are suited to a winter sojourn only. The thermometer may reach 100° as early as April and well into October, and we cannot deny that such temperatures are injurious, and involve direct danger on exposure to the sun's rays in this almost treeless desert. However, the removal to a cooler region for the summer involves so short a journey that this region will unquestionably achieve good results in selected cases during the cooler months. Similar in winter, much cooler in summer, therefore in general far superior, are the stations of the Mexican plateau. Unfortunately, the primitive social conditions and scanty accommodations of this region relegate its extensive employment to the not very near future.

The above concise summary of the more important American climatic stations suited to the special requirements of tuberculous children will afford the physician general principles for a rational selection. For details he will have to consult special works and local guides.[1]

[1] For references to available works see the writer's "Climatic Treatment of Children." New York: Rebman Company. 1907.

XXXIV.

MEDICAMENTS EMPLOYED IN THE MANAGEMENT OF THE TUBERCULOUS AND TUBERCULOUSLY DISPOSED CHILD.

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In the treatment of tuberculosis in the child drugs may play a useful although subsidiary part. The physician's chief reliance must in all cases be placed on a full, continuous supply of fresh air; on as much sunlight as may be obtainable; on a diet readily digestible and highly nutritious; and on rest. Exercise, if permitted, should be carefully regulated to avoid influencing unfavourably any local area of infection, remembering that fatigue, especially in the tuberculous child, does much harm.

During the whole course of treatment the physician must bear in mind the pre-eminent importance of maintaining at its maximum the functional activity of the stomach and small intestine. Important as this is in the adult, it is still more important in the child, who, in addition to the ordinary demands of tear and wear, has also to obtain material for growth. For this reason any disorder of the alimentary tract must be promptly corrected by the use of such stomachics as may at the time be indicated,[1] and throughout the treatment care must be taken that no drugs impair the appetite or interfere with the digestion and absorption of food.

Classification of Medicaments.

Drugs may be employed in the treatment of tuberculosis with the object:

(1) Of influencing general nutrition;

[1] "The drugs most frequently useful are alkalies and bitters, especially nux vomica."—Lindsay: "Diseases of the Lungs and Heart," 3rd edition, p. 194. London: Baillière, Tindall and Cox.

(2) Of inhibiting the development, or antagonizing the local activity, of the invading organism;

(3) Of relieving distressing symptoms which depress the resisting powers of the patient.

Under these divisions we propose to discuss those medicaments whose reputed value has received endorsement by clinical experience.

Drugs Employed to Improve General Nutrition.

Cod-liver oil has for many decades been regarded as one of the most valuable medicaments in the treatment of all forms of tuberculous disease. It differs from other oils in containing a considerable amount of unsaturated acid, together with traces of iodine and phosphorus. The brown oils contain, in addition, decomposition products from the liver of doubtful therapeutic value. As a food it is more readily absorbed and oxidized than other fats. J. W. Wells[1] has recently, by experiment on young pigs, corroborated the clinical experience of the past, and shown that cod-liver oil added to the diet notably increases nutrition, as indicated by a rapid gain in weight; under its use healthy cell formation is stimulated and the fibrosis of infected glands is favoured. Its therapeutic activity appears to be increased when the oil is given in a carefully prepared emulsion. Continued fever and any gastric or intestinal catarrh contraindicate temporarily its employment. Cod-liver oil is readily absorbed through the skin, and in young children may be given advantageously by inunction. When used in this way its rank, nauseating odour is difficult to overcome, even when the anointing is followed by a warm bath. Rohden[2] recommends for employment in this way an ointment of cod-liver oil, lanolin, and glycerin, rendered aromatic by the addition of balsam of Peru, with the oils of cinnamon and thyme. Pharmacologists have not yet decided wherein lies the special therapeutic value of this oil. Gautier isolated from the darker oils several alkaloidal principles soluble in alcohol. To these he attributed therapeutic activity, and Bouillot[3] affirms that these stimulate circulation and general nutrition, and increase nitrogenous metabolism.

Morrhuol is a bitter aromatic liquid containing these principles in variable quantities, with free oleic acid and minute traces of iodine, bromine, and phosphorus in combination. Many so-called "tasteless" preparations of oil also have been recently placed on the market containing in alcoholic solution these non-fatty constituents of the oil, chiefly leucomaines. Their therapeutic value is seriously questioned.

[1] Wells, J. W.: *British Medical Journal*, October 18, 1902; also "A Comparative Study of the Influence of Cod-Liver Oil and Cod-Liver Oil Emulsion upon the Nutrition of Normal and Tuberculous Pigs." Manchester, 1907.

[2] Rohden: *Therapeutische Monatshefte*, August, 1901.

[3] Bouillot: *Comptes Rendus de l'Académie des Sciences*, cxv. Paris, 1892.

Several substitutes have been proposed for cod-liver oil. *Lipanin* is a combination of olive oil with 6 per cent. of free oleic acid.[1] It is not unpalatable, is readily emulsified, and has been employed with some measure of success.

A *petroleum emulsion* has also been placed upon the market. As the petroleum is quite unabsorbable, it can only be regarded as an emollient to the intestinal tract and as a gentle laxative.

Bynin, or malt extract, from the diastase it contains, has a certain digestive value if given at the commencement of a meal. It has also a definite food value.

Phosphates, Hypophosphites, and Glycero-phosphates. — The alkaline phosphates and the hypophosphites were originally introduced to the profession under the belief that they could be appropriated by the system, and supply the wants of the phosphorus-containing tissues. Evidence for this belief is wanting. If made use of in the system it must be to a very small extent, for careful experiments show that they are excreted without change, chiefly by the urine, but in part by the intestines. More recently the glycero-phosphates have been brought forward as more assimilable, but experimental evidence does not give much support to this statement. These salts are generally administered in combination with iron, quinine, and strychnine, and to these more potent drugs pharmacologists attribute the benefit that may arise from their administration. Nevertheless, they are in very general use at the present day for the treatment of the early and apyrexial stage of tuberculosis in children, and good clinical results are reported by many. The salts of lime appear to be indicated rather than those of the alkalies. Michelozzi,[2] in Pisa, claims to have obtained a complete cure in infected pigs by means of a lime containing serum.

Arsenic.—There is considerable experimental evidence to indicate that arsenic in small therapeutic doses increases the number of red blood cells by stimulating the bone-marrow, and produces a general capillary dilatation with hyperæmia, leading to increased nutrition. In small or moderate doses, well diluted, and administered over long periods, it is strongly recommended in the apyrexial stage of early tuberculosis by the majority of pediatrists. It increases the appetite, improves any existing anæmia, and lessens the tendency to bronchial catarrhs.

Sodium cacodylate is an organic salt of arsenic, which owes its efficacy to the slow, but only partial, liberation of the arsenic ion. Owing to this liberation taking place to a certain extent in the stomach, it is very apt, when given by the mouth, to disturb digestion. The best effects are obtained when it is given hypodermically. *Atoxyl* contains nearly

[1] Von Mering: *Therapeutische Monatshefte*, pp. 49, 233, 1888.
[2] Michelozzi: *Il Morgagni*, 21, 1906, quoted in *Pediatrics*, p. 301, May, 1907.

40 per cent. of arsenic, but is less toxic than other preparations of arsenic when employed hypodermically. Clinicians, however, are still uncertain whether these organic preparations of arsenic, when given by the mouth, have any advantage over the inorganic.

Iron is of distinct value in the anæmia of early tuberculosis in children. In many cases tuberculous anæmia presents no special characteristics, but in others pallor only exists, and an examination of the blood reveals a high hæmoglobin percentage and full complement of red cells.[1] Trousseau, speaking of adults, emphasized the fact that tuberculous anæmias require caution in the use of iron; and although children, as a rule, bear it better than do adults, not infrequently it disturbs, and must be discontinued. Iron is contraindicated in pyrexial conditions, and in cases with any existing irritability of the gastro-intestinal tract.

Strychnine is a powerful respiratory stimulant, and its employment in tuberculosis has been strongly recommended by many writers. It may be given either in moderate doses over long periods in association with other drugs, or in gradually increasing doses for limited periods, till slight physiological symptoms make their appearance.

Medicaments Employed to Inhibit the Development of, or Antagonize the Local Activity of, the Invading Organism.

Tuberculins.—The various tuberculins have during the past few years claimed much attention. Indiscriminately used by careless or inexperienced men they are undoubtedly dangerous, but used cautiously in selected cases, in small but gradually increasing doses, distinct benefit is claimed from their employment. Their use has thus far been confined chiefly to adults; but, in a recent paper, Clive Rivière emphasizes their value in the treatment of tuberculosis in childhood. When the infection is strictly localized, the employment of tuberculin is followed by marked improvement, not only in the local condition, but also in the constitutional symptoms. With a more diffuse infection the improvement, although not so rapid, is in many instances noticeable; while the proneness to infection by other organisms, so notable in many tuberculous cases, is lessened, evincing an increase in the resisting power of the system.

In employing it, it is important that the primary dose should not produce any objective reaction and only a minimum of subjective. This dose should be very gradually increased; on the appearance of increased symptoms of reaction, it should be diminished by the extent of several consecutive increases. Further increases in the dose should be made very cautiously and at longer intervals.

[1] Labbé: "Les anémies des Tuberculeux," *Revue de Méd.*, p. 225, 1906.

The tuberculin preparations in most frequent use to-day are as follows:

1. The old tuberculin of Koch. A glycerin extract from cultures of the tubercle bacillus, chiefly employed as a diagnostic agent, but still, in very small doses, used by some as an immunizing agent.

2. Koch's new tuberculin, 1897 (T. R.), is said to contain in suspension the insoluble portion of the bacilli in very fine disintegration. It has no advantage over the preceding, and is of less uniform strength.

3. New tuberculin, Koch (bacillen emulsion). This contains a suspension of pulverized bacilli in water with glycerin. It is to-day the most commonly used of all the tuberculins. Its manufacture is difficult and requires most scrupulous care.

4. Denys' tuberculin. Very similar to Koch's original tuberculin, but unaltered by heat and by the addition of glycerin.

5. Tuberculocidin and antiphthisin (Klebs). The latter is a highly purified preparation, from which, it is said, injurious products are excluded.

6. Beraneck's tuberculin, prepared from bouillon cultures, with pulverized tubercle bacilli in addition.

7. Spengler's tuberculin, prepared from bovine bacilli instead of human.

8. Landmann's tuberculol represents the tuberculous toxin qualitatively unchanged, and includes the toxins of both culture fluid and bacterial cells.

9. Maragliano's anti-tuberculous serum.

10. Marmorek's anti-tuberculous serum.

Both have been employed with benefit. They are antitoxic, antibacterial, and agglutinating; suitable only in the very earliest stage and as a prophylactic.

Antiseptics.—Of these creosote and iodine, and their derivatives, are the most important.

Creosote, obtained by distillation from beech-wood, consists of a mixture of guaiacol and creosol in uncertain proportions. It is rapidly absorbed from the stomach and eliminated by the urine. Little or no elimination of it takes place by the lungs, and the sputum of phthisical patients treated with creosote is as virulent as that of others not so treated. It has, however, a sedative and antiseptic action on the gastric mucous membrane. Creosote has been much employed in the treatment of pulmonary tuberculosis; and many eminent observers have expressed themselves as favourably impressed with the results obtained. It certainly, in many cases, improves the appetite and checks intestinal fermentation, thus favouring nutrition. In some instances it has been given in gradually increasing doses, till large amounts were taken (30 to 40 minims daily). No special benefit followed such

heroic dosage; caution must be exercised lest damage to the kidney structures ensue.

Guaiacol is more certain in its composition and less irritant in its action than creosote, and has not such a disagreeable odour and taste. Many have recommended it as preferable. Jacobi[1] states that under its use the appetite and digestion improve, the cough becomes looser and less frequent, and the body-weight increases.

More recently both creosote and guaiacol have been replaced by their acid esters, which have the advantage of being tasteless, but are also inactive till they are slowly broken up in the intestine. Many of these preparations have been placed on the market, but as their activity depends on the creosote or guaiacol, the particular acid with which they are combined is comparatively immaterial. These salts are readily taken by children, and may be given after food in any bland liquid. When large doses are given a portion of the salt will escape unchanged in the fæces. The more important are the following:

Creosote carbonate (creosotal), guaiacol carbonate (duotal), guaiacol benzoate (benzosol), guaiacol valerianate (geosote), guaiacol potassium sulphonate (thiocol), guaiacol cinnamate (styracol).

Iodine Preparations.—Of these *iodoform* is the most frequently employed in tuberculosis, and experimental work would indicate that it has a slight modifying influence in checking the activity of the bacillus. Its internal administration was strongly recommended by Semmola, but it is rarely used in this way at the present day. Its value as a local application in surgical tuberculosis is, however, generally recognized. Many clinical reports testify to its value when applied locally to tuberculous ulceration in the upper respiratory passages. Suspended in glycerin it is frequently employed by surgeons[2] as an injection into tuberculous joints and for the local treatment of tuberculous nodes and abscesses.

Vioform has been introduced as a substitute for iodoform. Its chemical composition is complex. It is a bulky, greenish powder, containing about 41·5 per cent. of iodine. Doll asserts that vioform is destructive to the tubercle bacillus, and states that it has been employed in experimental tuberculous peritonitis with excellent results. It has not yet come into general use.

Hetol.—Sodium cinnamate, strongly recommended by Landerer[3] for use intravenously in 5 or 10 per cent. solution with physiological salt solution. An inflammatory reaction is said to be set up in the neighbourhood of tuberculous foci, leading to their encapsulation and final

[1] Jacobi: "Therapeutics of Infancy and Childhood," 3rd edition, p. 166. New York.

[2] Koenig: "Lehrbuch der Speciellen Chirurgie," Bd. cxi., p. 278. Berlin.

[3] Landerer: "Die Behandlung der Tuberculose mit Zimmt Saure." Leipzig, 1898.

cicatrization. Great care is necessary. Danger exists in the case of foci not equally advanced lest a reaction desirable for one be too great for others, and thus further dissemination of the bacillus take place. It is most successful when only one focus of infection is present; in children such a condition must be rare.

Drugs used for the Relief of Symptoms.

To control pyrexia the physician to-day depends chiefly on rest, abundance of fresh air, and hydro-therapy. In some cases, however, in children, one of the antipyretics, cautiously employed, may occasionally be of advantage, securing sleep and relieving nervous symptoms. Of this group the most effective appears to be *pyramidon* (di-methyl-amido-phenazone). Its action is slower than other members of the group, but more permanent, and the effect on the circulation is less depressing. Pyramidon has been combined with camphoric acid, advantageously associating the anhydrotic action of the latter with the sedative and antipyretic action of the former. *Quinine* may also be employed in small doses.

To control cough, antiseptic inhalations are frequently of much service. Many volatile drugs of the antiseptic group in very dilute vapour exert a favourable influence on the upper portions of the respiratory tract, allaying irritation and checking secretion. The more important of these are *iodine*, *carbolic acid*, *creosote*, *menthol*, *eucalyptol*, and *oil of pine*. Respiratory sedatives, such as *codeine* and *heroin*, should only be employed to secure rest at night.

Hæmoptysis and night-sweats call for the same remedies as when occurring in adults.

Intestinal ulceration in children is often very difficult to relieve. The condition demands a very careful dietary; the employment of one of the salts of bismuth in large doses, and the use of opium, chiefly by the rectum.

XXXV.

THE DIAGNOSTIC AND THERAPEUTIC USE OF TUBERCULIN AND ALLIED PREPARATIONS IN INFANCY AND CHILDHOOD.

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In no department of medicine is more striking activity being exhibited than in that which pertains to the use of tuberculin both for diagnosis and treatment. Discovered by Koch in 1889, but for a while discredited, the use of tuberculin has now taken firm root, and is no more to be displaced. New methods for its administration, new preparations, crowd upon us, and, on account of their safety, convenience, and worth, tend to replace those of a less enlightened period. But the older methods still claim attention, and we cannot yet omit them from our consideration. Of these, the diagnostic use of tuberculin injections, though but little practised in this country, has many exponents on the Continent and in America. The same may be said of the "clinical method" of tuberculin-therapy, to be presently described. The former seems destined to be superseded by the ophthalmo-reaction. The place of the latter is filled in this country by what will be described here as the "scientific method" of tuberculin administration.

I. DIAGNOSIS.

The Subcutaneous Injection of Old Tuberculin.

The "tuberculin test" (Koch, 1890) depends on a heightened susceptibility on the part of the tuberculous to the poisons of the tubercle bacillus. This shows itself in what is termed a "reaction." The reaction consists in—(1) *A general disturbance*, as malaise, nausea, pains in head and limbs, accompanied by a rise of *temperature* of at least 0·5° C. (0·9° F.). (2) A *local change*, the result of active hyperæmia of the tuberculous focus. This may show itself in lupus by visible redness and swelling, in pulmonary tuberculosis by increased cough and

expectoration, and sometimes by alteration of lung signs. There may, in addition, be swelling and pain at the point of injection of the tuberculin—the *stichreaktion* of the Germans.

The original *dosage* of Koch was 1 milligramme, followed, if no "reaction" resulted, by 5 milligrammes, and later by 10 milligrammes. These doses have since been somewhat modified, and in Germany it is now customary (Bandelier and Roepke[1]) to begin with $\frac{2}{10}$ milligramme, and rise, with a few days' interval, to 5 milligrammes, and in some cases to 10 milligrammes. Many make 5 milligrammes the maximum dose. Half doses are recommended for children, beginning with $\frac{1}{10}$ milligramme (Bandelier and Roepke, Comby[2]).

Now, it must be observed that susceptibility to tuberculin rises with each injection, so that even the healthy react to large doses. The important point, then, is to find such a dose as will cause a reaction in the tuberculous, but not in the healthy. At the Tuberculosis Congress of 1905 (Paris), Moeller, Löwenstein, and Ostrovsky described a method by which the same small dose ($\frac{2}{10}$ milligramme) is repeated at intervals of three to four days up to four injections. The rising susceptibility is sufficient, without increase of dose, to secure a reaction in the tuberculous, and the method has found much favour among French clinicians (Claisse, Bezançon, Labbé[3]).

As regards the *clinical value* of this test, its inutility in the presence of fever greatly impairs its usefulness. A temperature above 98·6° F. in the axilla (37° C., Koch), or 99° F. in the mouth, is generally given as a contraindication to its use. It is, moreover, objected that a percentage of people apparently not tuberculous give the reaction. This is especially so with the method of increasing dosage employed in Germany, and Berlin clinicians reported reactions in 27 per cent. of the non-tuberculous sick, and in 8 per cent. of healthy people. Some (Franz and Ludwig) give still higher figures. This percentage of apparent failures has largely discredited the test, but it must be remembered that latent or obsolete tubercle may be present in the apparently healthy, and that the test may be specifically correct where it fails clinically. The experience of veterinarians supports this view. Among them the value of the test is strongly upheld, though even here a "reaction" is occasionally obtained in a healthy animal (Nocard and Bang).

On the other hand, tuberculous cases are found where no "reaction" is obtainable. These are mainly patients with advanced forms of

[1] Bandelier and Roepke: "Lehrbuch der Spezifischen Diagnostik und Therapie der Tuberkulose." Würzburg, 1908.

[2] Comby: "Ophthalmo-réaction tuberculeuse chez les enfants," *Bull. et Mém. Soc. Méd. des Hôp. de Paris*, vol. xxiv., p. 766. 1907.

[3] Claisse, Bezançon, Labbé: "L'emploi de la tuberculine pour le diagnostic de la tuberculose," *ibid.*, vol. xxiv., pp. 689, 700, and 703. 1907.

pulmonary tuberculosis where the diagnosis is not uncertain, and also many under treatment with tuberculin. When these are eliminated there is no doubt that a negative result is of value.

Children.—In children's practice especially, useful results have been obtained. Comby[1] extols the method as pursued by Mettetal in his clinic. Binswanger[2] shows useful results among 261 cases tested. Of 42 autopsies among these, 41 showed a correct result (16 positive and 25 negative); in the remaining case the test was at fault. Rotch and Floyd[3] have used the method widely, and obtained a positive reaction in 95 per cent. of tuberculous cases. They come to the conclusion that a negative result does not exclude tuberculosis, though it affords strong evidence against it. Schick[4] remarks that a "protracted reaction," with disturbance lasting over several days, is common in children; he also points out the prevalence among them of the *stichreaktion* already mentioned, and attaches to it considerable diagnostic importance. These authors are agreed that no harm ever occurs as a result of the injection. Reiche,[5] on the other hand, has seen several instances of collapse temperature with restlessness in healthy infants after doses of $\frac{3}{10}$ to $\frac{5}{10}$ milligramme. Especially interesting are the results in new-born babies obtained by Schreiber[6] and Epstein.[7] The test was used as a means of determining whether tuberculosis was ever of congenital origin, and many of the infants were the offspring of tuberculous mothers. In no case was a reaction obtained, though doses as high as even 5 centigrammes were employed.

Diagnostic Use of Tuberculo-Opsonic Determination.

The "opsonins" (Wright, 1903) are substances present in the serum which act on the bacilli, and render them suitable for phagocytosis by the leucocytes. They are found to exist against organisms which do not form extra-cellular toxins (tubercle bacillus, streptococcus, staphylococcus, etc.), and for which the serum appears to possess no bacteriolytic power. The determination of the opsonic index is not a complicated proceeding, and a knowledge of its details

[1] Comby: "Les injections sous-cutanées de tuberculine pour le diagnostic de la tuberculose chez les enfants," *ibid.*, vol. xxiv., p. 706. 1907.

[2] Binswanger: "Ueber probatorische Tuberkulininjectionem bei Kindern," *Arch. f. Kinderheilk.*, vol. xliii., p. 121. 1906.

[3] Rotch and Floyd: "The opsonic index and the tuberculin test," *Journ. of Am. Med. Assoc.*, vol. xlix., p. 633. 1907.

[4] Schick: "Die diagnostische Tuberculinreaktion im Kindesalter," *Jahrb. f. Kinderheilk.*, vol. lxi., p. 122. 1907.

[5] Reiche: "Diagnostische Tuberkulininfectionen und Impfungen bei Säuglingen," *Arch. f. Kinderheilk.*, vol. xlvii., p. 308. 1908.

[6] Schreiber: "Ueber das Koch'sche Heilverfahren," *Deut. Medizin. Wochenschr.*, vol. xvii., p. 306. 1891.

[7] Epstein: "Ueber die Anwendung Koch'scher Injectionen im Säuglings- und ersten Kindesalter," *Prag. Medizin. Wochenschr.*, vol. xvi.. pp. 4 and 13. 1891.

must be presumed here, but a word as to its accuracy is necessary, in face of the criticism to which it is not unnaturally being subjected.

The question seems to me to turn upon the *amount of accuracy required*, since it is admitted (Fitzgerald, Whiteman, and Strangeways[1]) that error *can* be brought near to vanishing-point if only a sufficient number of leucocytes are counted. For clinical purposes I consider that accuracy is still sufficient, with an error of 10 per cent. (and occasionally 20 per cent.) between two entirely separate observations. This amount of accuracy I obtain for myself by the help of means to be presently noticed. In some hands more accuracy might perhaps be achieved with the same amount of labour; in the hands of the novice and certain people unfitted by natural want of dexterity the method is valueless. Sir A. E. Wright[2] claims that an error of 5 per cent. is seldom exceeded in his laboratory; Park and Biggs,[3] collecting opinions from all the large American laboratories, find an average error of 10 per cent., an error of 20 per cent. in every ten determinations, and exceptionally an error of 100 per cent.

To obtain useful results, considerable manual dexterity and much practice are required. The less are these available, the greater must be the amount of labour given to the task. There are some whose counts should run into millions, and they are advised to abstain. A point largely overlooked in determining accuracy is the *number of bacilli* counted. What avails it to count 100 leucocytes if they contain only 20 to 30 bacilli? At least 150 bacilli must be counted, whatever the number of the cells containing them. For this purpose the emulsion should be used thick enough to give a phagocytic index near 2·0 (*i.e.*, two bacilli per leucocyte), and this can and should be obtained without the presence of gross clumps. To insure this, I find it useful to keep a thick emulsion over several weeks, diluting and centrifugalizing at the moment of use.

The following principles are those employed in the diagnosis of tuberculosis by means of the opsonic index:

1. The index for normal people is found to vary between 0·8 and 1·2 (Bulloch). Where the index is persistently below this, if there is a localized infection which may be tuberculous, it probably is so. Where the index remains persistently normal, the disease is not tubercle; where it is high, and especially where it fluctuates from time to time, there is active tuberculosis. In certain cases this "fluctuation test"

[1] Fitzgerald, Whiteman, and Strangeways: "An Inquiry into the Value of the Opsonic Index," *Bull. of Committee for Study of Special Diseases*, vol. i., p. 115. 1907.

[2] Wright: "The Principles of Vaccine Therapy," *Lancet*, vol. ii., p. 423. 1907.

[3] Park and Biggs: "The Opsonic Index as a Guide to Regulate the Use of Vaccines in the Treatment of Disease," *Journ. of Medical Research*, vol. xvii., p. 77. 1907.

can be artificially obtained by actively congesting the suspected area either by manipulation or by exercise (Meakin and Wheeler[1]).

2. The effect of a small dose of tuberculin on the opsonic index is of diagnostic value. In the tuberculous it leads to a "*negative phase*," followed by a "positive phase." The "negative phase" is absent in non-tuberculous subjects (Lawson and Stewart,[2] Fraser[3]).

3. Where the local disease whose nature it is desired to test contains fluid (abscess, pleural effusion, etc.), the bacteriotropic power of this fluid is lowered towards the organism causing the lesion—*i.e.*, the opsonic index of the fluid is found to be lower than that of the patient's blood-serum. This test can be applied for any micro-organism, including the tubercle bacillus.

4. The "heated serum test" depends on the fact that the serum of the tuberculous and "tuberculinized" retains more of its opsonic power, after heating to 60° C. for ten minutes, than does normal serum. The latter loses about nine-tenths of its strength, but tuberculous serum only loses about half its strength as a result of heating.

The comparative value of these four tests has been variously estimated by different observers. The first is probably in widest use at the present time.

The Cutaneous Tuberculin Reaction.

The cuti-reaction was introduced by von Pirquet[4] to the Berlin Medizinische Gesellschaft on May 8, 1907. It consists in a skin vaccination with tuberculin carried out in a manner similar to that for vaccinia; the "reaction" appears in twenty to twenty-four hours (Sicard[5]), or thirty to forty-eight hours (Dufour[6]), and passes on to the formation of minute papules. Vallée has used the test with success on animals, but Arloing[7] describes indifferent results and does not accept its specificity. For the human the results are admittedly unreliable. It appears that adults and children above the age of two years react whether tuberculous or not, so that its applicability is confined to infants. Among these, according to von Pirquet, 88 per cent. of the tuberculous react, but 12 per cent. (mostly cachectic, or with miliary tuberculosis) give no

[1] Meakin and Wheeler: "Observations on the Opsonic Index of Patients undergoing Sanatorium Treatment for Phthisis," *Brit. Med. Journ.*, ii., p. 1396. 1905.

[2] Lawson and Stewart: "A Study on some Points in Relation to the Administration of Tuberculin T. R.," *Med. Chirurg. Trans.*, vol. lxxxix., p. 45. 1906.

[3] Fraser: "On the Value of the Tuberculo-opsonic Index in Diagnosis," *Glasg. Med. Journ.*, vol. lxvii., p. 194. 1907.

[4] Von Pirquet: "Ueber Tuberkulinimpfung," *Deut. Med. Wochenschr.*, vol. xxxiii., p. 865. 1907.

[5] Sicard: Discussion on "Le Rheumatisme tuberculeux," *Bull. et Mém. Soc. Méd. des Hôp. de Paris*, vol. xxiv., p. 623. 1907.

[6] Dufour: Cuti-réaction à la tuberculine chez les enfants par la méthode de von Pirquet," *ibid.*, vol. xxiv., p. 627. 1907.

[7] Arloing: "Sur la cuti-réaction à la tuberculine," *Soc. de Biol.*, vol. lxiii., p. 247. 1907.

reaction. Of the apparently healthy, 16 per cent. react. The method has paved the way to the ophthalmo-reaction, by which it has now been superseded.

The Ophthalmo-Tuberculin Reaction.

The idea of using the conjunctiva for a tuberculin test first occurred to Wolff-Eisner,[1] who described the method on May 15, 1907, at a meeting of the Berlin Medizinische Gesellschaft. He used a solution of 10 per cent. strength, but this was modified by Calmette,[2] of Lille, who applied the test with a 1 per cent. solution. Even this strength was found by Comby[3] to cause very severe inflammation on occasion, and he introduced a ½ per cent. solution for children with better results. The ½ per cent. solution appears to be that most used at the present time.

The *method* consists in the instillation of a drop of ½ per cent. tuberculin into one eye and watching for a "reaction." The solution mostly used has been prepared from old tuberculin by precipitation with alcohol, the object being to get rid of the glycerin contained in this preparation. But MacLellan[4] and Krause and Hertel[5] have shown that glycerin in such strength causes no inflammation, and the latter authors urge, with good reason, the use of the old tuberculin dissolved in 0·3 per cent. phenol as a useful standard preparation within the reach of all.

The "reaction" begins in five to six hours, and is well marked in twenty-four hours, and this is the best time to decide on its presence. The inflammation lasts several days, and may still be noticeable at the end of weeks. It seems suitable at this point to warn against the use of the test in cases of disease of the cornea or conjunctiva. This warning is especially applicable to its use for children, since it is in cases of corneal ulcer and phlyctenular conjunctivitis that trouble is apt to occur. It appears that even healed lesions may reopen (Krause and Hertel), and severe conjunctivitis leading on to ulceration is not uncommonly seen (De Lapersonne,[6] Collin[7]). Schultz-Zehden[8] attributes these troublesome results to Calmette's special preparation, and

[1] Wolff-Eisner: Discussion in Berliner Medizin. Gesellschaft, *Berlin. Klinische Wochenschr.*, vol. xliv., p. 700. 1907.

[2] Calmette: "Sur un nouveau procédé de diagnostic de la tuberculose chez l'homme par l'ophthalmo-réaction à la tuberculine," *Compt. rend. de l'Acad. de Science*, vol. cxliv., p. 1324. 1907.

[3] Comby: "Oculo-réaction a la tuberculine chez les enfants," *Bull. et Mém. Soc. Méd. des Hôp. de Paris*, vol. xxiv., p. 824. 1907.

[4] MacLellan: "Observations on the Ophthalmo-reaction to Tuberculin," *Brit. Med. Journ.*, vol. ii., p. 1642. 1907.

[5] Krause and Hertel: "Kritische Bemerkungen und Erfahrungen über die Bewertung der Ophthalmoreaktion," *Med. Klin.*, vol. iv., p. 117. 1908.

[6] De Lapersonne: "L'ophthalmo-réaction, présente-t-elle quelques dangers pour l'œil?" *La Presse Médicale*, vol. xv., p. 797. 1907.

[7] Collin: "Ueber Nachteile und Gefahren der konjunktivalen Tuberkulinreaktion," *Med. Klin.*, vol. iv., p. 149. 1908.

[8] Schultz-Zehden: "Die stellung des Augenarztes zur Ophthalmo-Reaktion," *Therapeut. Monatshefte*, vol, xxii., p. 177. 1908.

declares that they do not occur with ½ per cent. or even 1 per cent. solution of old tuberculin. Very interesting are the "lésions oculaires tardives" described by van Durme and Stocké.[1] These appear many days (ten to fifty-seven among five cases) after the installation of tuberculin, and consist of papules, which these writers believe to be true "tubercles" formed round dead bacilli contained in the preparation applied.

Three "degrees of reaction" have been described (Eyre, Wedd, and Hertz,[2] Letulle[3]), according to the amount of inflammation, but the distinction has not been shown at present to possess any clinical value. The question of "positive" or "negative" is that which we are at present concerned to answer, and of this I do not think there can often be doubt.

An enormous amount of material has already been published, and some idea of the *clinical value* of the test is already available, but it will need much post-mortem confirmation before we can reach a final decision as to its reliability. At this stage of the inquiry it is needless to burden ourselves with the results obtained in "doubtful" cases, and these have consequently been omitted from the following figures:

TABLE INDICATING RESULTS OBTAINED IN TUBERCULOUS CASES BY THE OPHTHALMO-REACTION.

Observer.	Number of Cases.	Percentage of "Positive" Results.
Cohn	86	70
Krause and Hertel	549 (collected cases)	90
Eisen	?	66
Andeoud	261	94
Letulle	75	95

Among admittedly tuberculous cases, therefore, a positive result is obtained in some 70 to 95 per cent. If a closer examination is made, it is apparent that failure occurs mainly among cases of *advanced* tuberculosis. Thus Cohn[4] and Eisen[5] obtain only 50 per cent. of positive results among cases of advanced phthisis, but a much larger percentage among earlier cases (Cohn 93 per cent., Eisen 78·9 per cent.). As with other forms of tuberculin test, cases of advanced tuberculosis, such as phthisis with cachexia and cavity formation, and also cases progressing to a near death (miliary tuberculosis, etc.), make no response

[1] Van Durme and Stocké: "Lésions oculaires tardives après ophthalmo-réaction par la tuberculine," *Presse Médicale*, v. xvi., p. 172. 1908.

[2] Eyre, Wedd, and Hertz: "The Tuberculin 'Ophthalmo-reaction' of Calmette," *Lancet*, vol. ii., p. 1752. 1907.

[3] Letulle: "L'ophthalmo-réaction à la Tuberculine," *Bull. et Mém. Soc. des Hôp de Paris*, vol. xxiv., p. 709. 1907.

[4] Cohn: "Ueber die Ophthalmoreaktion auf Tuberkulin," *Berlin. Klinische Wochenschr.*, vol. xliv., p. 1507. 1907.

[5] Eisen: *Beiträge zur Klin. der Tuberkulose*, viii., No. 4. Würzburg.

to the ophthalmic test. Calmette, Breton, and Petit[1] have obtained similar results by animal experiment. They found that rabbits injected with a moderate dose of tuberculin, after some hours gave the ophthalmo-reaction; when, however, lethal doses were given, no response could be obtained to the instillation of tuberculin. In such advanced cases as we have described the diagnosis is seldom in doubt, and the need for the test is not largely felt.

Among early cases of tuberculosis, where the diagnostic help is valuable, the test appears to be of considerable utility, though the result is not conclusive. A negative result appears to be of more value than a positive one, for reasons to be presently mentioned.

For cases believed to be *non-tuberculous* the following figures have been given:

TABLE INDICATING RESULTS OBTAINED IN NON-TUBERCULOUS CASES BY THE OPHTHALMO-REACTION.

Observer.	Number of Cases.	Percentage of "Positive" Results.
Cohn	188	5·3
Krause and Hertel ...	672 (collected cases) ...	47·0
Andeoud	303	17·0
Letulle	50	38·0
Mantoux[2]	200 (children)	8·0

Cohn records a positive reaction in eight cases of enteric fever (among twelve cases tested), but Austin and Grünbaum[3] obtained negative results in eight cases of this disease.

The precise *clinical value* of the ophthalmo-reaction is thus somewhat difficult to determine. The discrepancies in the percentages given above may be due partly to the figures applying in some cases to healthy, in others to "sick," people, and partly, perhaps, to a difference in the strength (1 per cent. and ½ per cent.) and variety of tuberculin used for the test. In any case, it is obvious that a very definite percentage of apparently healthy people give a reaction with this as with other varieties of the tuberculin test. How far this corresponds to latent and unsuspected tuberculous lesions time and a considerable amount of post-mortem evidence can alone determine. It is significant that it is among veterinarians especially that tuberculin still holds its position as a specific test, and it seems probable that, if the same prompt confirmation as is applied to cattle were applicable to humans, some hidden focus would be found in most positive cases. It has

[1] Calmette, Breton, and Petit: "Étude expérimentale de l' 'ophthalmo-réaction' à la tuberculine," *Soc. de Biol.*, vol. lxiii., p. 296. 1907.

[2] Mantoux: "Ophthalmo-réaction chez deux cents enfants non malades," *Révue de la Tuberculose*, vol. v., p. 57. 1908.

[3] Austin and Grünbaum: "Some Experiences with the Tuberculin Ophthalmic Reaction," *Proc. of Roy. Soc. of Med.* (*Patholog. Section*), vol. i., p. 74. 1907.

often been remarked how few escape tuberculosis in some form during the course of an average lifetime.

A modification of the ophthalmo-reaction, which promises to give still more valuable results, has been described by Cohn. It consists in a repetition of the test after some weeks' interval (one to six weeks) in the *opposite* eye. A "positive" reaction was obtained by him in those tuberculous patients who originally failed to react, but for the non-tuberculous cases a further "negative" reaction resulted. The same eye must not be used, since in such case a reaction is said to occur indiscriminately alike in tuberculous and healthy. These results need further confirmation.

It has been necessary to deal at some length with the ophthalmic test as applied to adults before proceeding to a consideration of the reaction as it occurs in *children*. With regard to its applicability to tuberculosis in children, Comby, with a considerable experience, describes the results as satisfactory, but his figures are not sufficiently clear to prove convincing to all. He points out that the reaction in children is apt to be delayed. Mantoux, already cited, gives more valuable evidence. Among healthy children he finds a "positive" result in 8 per cent. (among 200 cases). On dividing these into age-periods, it is shown that among children from two to five years of age only 4 per cent. are positive, from six to ten years 9 per cent. are positive, and from eleven to sixteen years 10 per cent. are positive. This rising incidence corresponds in a striking manner with one's preconceived notions in regard to increasing probability of infection with the passage of time. Dufour and Bruslé[1] also publish cases, and have had "negative" results with advanced tuberculosis in children such as occur in adults. On the whole, it appears that the reaction will be at least as valuable for children as for adults, with the further advantage that a positive result is less open to suspicion of error than in adults who have run the gauntlet of tubercle for so many years.

II. THERAPEUSIS.

The therapeutic use of tuberculin dates from the introduction by Koch in 1889 of the preparation now known as "old tuberculin"; various results from its use, mainly unfavourable, were reported, and in 1897 the "new tuberculin" (T.R.) appeared. This is an emulsion of pulverized tubercle bacilli, and represents the "vaccines" generally; the earlier preparation was an "extract" prepared by concentration of the filtrate of a glycerin-broth culture. Since the introduction of these preparations a host of "tuberculins" have appeared, of which space only permits me to mention a few:

[1] Dufour and Bruslé: "Ophthalmo-réaction a la tuberculine chez les enfants," *Bull. et Mém. Soc. Méd. des Hôp. de Paris*, vol. xxiv., p. 831. 1907.

Extracts.—"Old tuberculin" and tuberculin (T.O.); Denys' tuberculin (B.F.) Beraneck's tuberculin; water extract (Maragliano); bovine tuberculin (P.T.O.).

Vaccines. — New tuberculin (T.R.); Koch's bacillary emulsion; Denys' tuberculin (B.E.); Tulase (von Behring); bovine tuberculin (P.T.R.).

The variety of preparations is somewhat paralyzing to superficial observation, but in practice their number matters very little. All contain in varying quantities the bacillary nucleo-proteid, which forms the active principle of the tuberculins, and it only behoves us to choose a suitable and readily obtainable preparation, and to study its peculiarities. It is stated that only a toxic immunity is called forth by the administration of the extracts, and that the vaccines are required to produce an anti-bacterial result. Wright states that the extracts also act as vaccines. The bacillary emulsion has the advantage of being both a vaccine and an extract, being virtually a mixture of the old and the new tuberculin.

It is common knowledge that the method of administration originally introduced by Koch led to much overdosing, and to results so disappointing that its use was nearly abandoned. With growing experience, however, the dosage was modified, and better results were recorded.

At the present time two methods of administration are practised, which may be called respectively (1) the *clinical method* (or *German method*, since it is the outcome of Koch's investigations), and (2) the *scientific method* (or *British method*, since it originates in the work of Sir A. E. Wright). On account of its superior age we will here give precedence to the former.

The Clinical Method of Tuberculin Administration.

We have seen that the administration of tuberculin in sufficient quantity leads to the phenomenon spoken of as a "reaction." This consists in an active congestion of the tuberculous focus, accompanied by general symptoms, and represents, no doubt, a protective response on the part of the body. The aim of the clinical method of treatment is to attain the *local hyperæmia* without going so far as to cause any general disturbance, and at the same time to establish, by cautious increase of dosage, a *tolerance* in the organism to the tuberculous poisons. The local hyperæmia supplies to the local lesion an abundance of whatever antibodies the patient's blood may possess; the increased tolerance raises the well-being of the patient by removing to some extent the symptoms which interfere with his progress, and especially the exacerbations which commonly mark the course of phthisis. We have seen (diagnosis) how readily the increased

susceptibility which leads to a "reaction" is obtained by repetition at short intervals of even the same small dose; it must be obvious how cautiously increase of dosage must be brought about during treatment to avoid this "reaction" and establish tolerance. The method has been especially used in the treatment of pulmonary tuberculosis, and there is a consensus of opinion in its favour among those who have had good opportunities of judging.

One of the most recent and interesting examples of the "clinical method" of treatment is that by "graduated labour" in sanatoria, as described by Paterson and Inman,[1] of the Brompton Hospital Sanatorium. By exercise the patient achieves an auto-inoculation, which by judicious increase can be made to lead to tolerance of the tubercle poisons, till even full navvy's work can be undertaken. No small advantage of this method is in the supply of "homologous" toxins in place of the foreign strain of tubercle bacillus introduced with tuberculin. The important rôle of "tolerance" in pulmonary tuberculosis is too little appreciated by the profession. It stands in much the same relation to this disease as does "compensation" to valvular heart disease, and a study of its peculiarities enormously widens our resources in the treatment of tuberculosis. It is this that makes the difference, secondary infections apart, in the aspect of two patients with equally advanced disease—the one "poisoned" with wasting, rapid pulse, fever; the other in fair enjoyment of life, and able to undertake a full day's work.

And now as to *dosage*. This varies with the preparation used, the object being, in most cases, to use the highest possible dose short of causing a reaction.

With *old tuberculin* the initial adult dose is usually $\frac{1}{10}$ milligramme of the original solution (1 c.c. = 1 gramme = 1,000 milligrammes), or if this causes a reaction, $\frac{1}{100}$ milligramme. Injections are given twice weekly, rising steadily to 1,000 milligrammes where this is borne, and the maximum dose is then repeated at longer and longer intervals during many weeks or months.

With *new tuberculin* Koch recommends an initial dose of $\frac{1}{500}$ milligramme (really $\frac{1}{2500}$ milligramme. See note, p. 294), with gradual increase at lengthening intervals up to 20 milligrammes.

The *bacillary emulsion* is started in doses of $\frac{1}{1000}$ milligramme (or smaller doses for susceptible cases), and the maximum dose is 10 milligrammes.

Where Petruschky's method of "Etappenbehandlung" is followed, a two or three months' "cure" is given every six months up to two

[1] Paterson: "Graduated Labour in Pulmonary Tuberculosis." Inman: "The Effect of Exercise on the Opsonic Index of Patients Suffering from Pulmonary Tuberculosis," *Lancet*, vol. i., pp. 216 and 220. 1908.

years of treatment, but many continue tuberculin treatment indefinitely so long as improvement continues.

For children are recommended doses of $\frac{1}{10}$ strength for infants, and $\frac{1}{4}$ to $\frac{1}{2}$ strength for older children (Bandelier and Roepke).

Results.—The claims put forward for this system of tuberculin administration mostly emanate from phthisis sanatoria. It is held that the percentage of cures is increased, and that in incurable cases the distressing symptoms are greatly ameliorated. It seems likely that there is ample justification for these claims, but the value of the recorded statistics is largely impaired by the fact that the cases treated are admittedly "selected." More important than statistics are the opinions expressed in its favour by many able clinicians of large experience. Trudeau,[1] during many years, has obtained good results with Denys' preparations. He finds 18 to 25 per cent. more "treated" than "untreated" of his sanatorium cases still living after fifteen years. Karl von Ruck,[2] of Ashville, U.S.A., has no doubt of the value of the "clinical method," and gets better results with the *new* (54·6 per cent. "cures") than with the old preparations (35·5 per cent. "cures") among 1,166 cases treated. Bandelier and Roepke recommend especially the "bacillary emulsion," but their results with the Perlsucht-tuberculin (P.T.O.) of Spengler show even a larger percentage of successes.

With regard to the therapeusis of tuberculosis in children, the aspect of the subject with which we are mainly concerned, but little material has hitherto been published on their treatment under the German method of administration. It must be borne in mind that pulmonary tuberculosis is a comparatively uncommon form of tuberculosis in children, and but few sanatoria for such cases are at present in existence. A. Moeller,[3] of Belzig Sanatorium, has published results of the treatment of nineteen cases in 1904. Among fifty-six phthisical children in the sanatorium, 16 per cent. were "cured" and 26 per cent. improved. Of these, nineteen received tuberculin treatment, with the result that 26·3 per cent. were "cured" and 31·6 per cent. improved. Once again the fallacy of "selection" must be borne in mind.

[1] Trudeau: "Tuberculin Immunization in the Treatment of Pulmonary Tuberculosis," *Amer. Journ. of Med. Science*, vol. cxxxiii., p. 813. 1907.

[2] Von Ruck: "Erfahrungen mit Tuberkulin und mit anderen Produkten des Tuberkelbazillus in der Behandlung der Lungenschwindsucht," *Zeitschr. f. Tuberkulose*, vol. xi., p. 493.

[3] Moeller: "Jahresbericht der Vereinsheilstätte und der Kinderheilstätte des Berlin-Brandenberger Heilstättenvereines," *Zeitschr. f. Tuberkulose*, vol. vii., p. 329. 1905.

The Scientific Method of Tuberculin Administration.

Certain classes of micro-organisms (diphtheria and tetanus) manufacture extra-cellular toxins, which can be neutralized in the body by the formation of antitoxins, or by the injection of antitoxins artificially prepared in other animals (passive immunity). Other bacteria (typhoid, cholera) are resisted by the formation by the body-cells of bacteriolysins which destroy the invader. There remain certain organisms (tubercle bacillus, pneumococcus, staphylococcus, etc.) against which the blood-serum appears to possess no bactericidal action; for these it remained for Wright to discover the presence of "opsonins." These bodies prepare the invading micro-organism for phagocytosis by the leucocytes, and the resistance of the host is dependent on their presence in sufficient abundance. They have been found to be largely specific for the different species of bacteria, and on their increase under the artificial stimulus of injection of dead bacteria the system of *vaccine-therapy* is founded. The "vaccine" which concerns us here is that prepared from the tubercle bacillus, and especially the "new tuberculin" (T.R.), and the "bacillary emulsion" where the whole substance of the bacillus is retained.

It has been found that the quantity of opsonin (to tubercle) among the healthy remains relatively constant (between 0·8 and 1·2), and if this is taken as a standard *the tuberculous* fall into certain classes outside this normal.

1. Those with an opsonic index below 0·8. These are cases of *localized tuberculosis*, and the deficiency in opsonins is found to exist especially at the tuberculous focus.

2. Those whose opsonic index is high or fluctuating. These are cases where the disease, on account of its wide extent or position, is in close relationship to the blood-stream Auto-inoculation, consequently, occurs readily or constantly, with the result that an ill-regulated vaccination leads to violent rises and falls of opsonic power, accompanied by symptoms similar to those of a tuberculin "reaction." Pulmonary tuberculosis in its later stages forms the best and commonest example of this type of tuberculosis.

It has been found that if the low opsonic index in localized tuberculosis is raised, the tuberculous lesion tends to heal; and it is further found that a rise of the index (*i.e.*, of the tuberculo-opsonic power of the blood) can be obtained by the injection of suitable quantities of tubercle powder (tuberculin). The object, then, of the "scientific method" of tuberculin administration is to *keep the opsonic power of the patient for the longest possible time at the highest possible figure.* For this purpose only minute doses are necessary or desirable, and no increase of dosage is made. "Tolerance" and "local hyperæmia" (see Clinical Method) are

not aimed at. The former is unnecessary, since the goal aimed at is *cure;* the latter is supplied when necessary by other means (the local application of heat, passive congestion, etc.).

It is for *localized tuberculosis* that the method is mainly suitable, and for this reason it belongs especially to the department of children's diseases, for it is on children that the great weight of localized or "surgical" tuberculosis falls. More generalized tuberculosis is suitable to this mode of administration only in so far as it can be "localized" by rest and other means, but the knowledge obtained by a study of the "scientific method" is a great help to the rational treatment of all forms of tuberculosis.

Dosage.—In dosage lies the secret of success or failure. Too little notice has been taken of the relation of dose to body-weight in the administration of tuberculin, and correspondingly disappointing results have been obtained. I began my own observations with a dose of $\frac{1}{10000}$ milligramme (originally called $\frac{1}{2000}$ milligramme[1]), but a careful study of the opsonic index soon showed me my error. I now use doses of about $\frac{1}{15000}$ milligramme for children of twelve years and upwards, $\frac{1}{20000}$ milligramme at five years, and $\frac{1}{60000}$ to $\frac{1}{40000}$ milligramme for children of one year old. Such doses suit average cases, but they should be controlled by the use of the opsonic index, and it is best to begin with a dose somewhat below the average strength. When the suitable quantity has been found its repetition will depend on the length of the "opsonic curve," intervals of two weeks or thereabouts being generally suitable. After a tuberculin injection the opsonic power (after a short "pre-negative" rise) drops (negative phase) for a day or two, then rises above the normal line (positive phase) and, after a week or more, sinks again, and the cycle is completed. The art of tuberculin administration consists in the adjustment of these phases to one another in such a way that the best possible clinical effect is obtained.

It remains only to say a few words about the *results* of treatment.

1. For *localized tuberculosis* tuberculin suitably administered is an almost certain remedy. The improvement is generally threefold: *Firstly*, there is a change in the *general health* as exhibited in appetite, weight, colour, and general "fitness"; *secondly*, there is a marked *mental change*, shown by increased cheerfulness and renewed interest in

[1] The *new tuberculin* (*T.R.*), supplied to this country and to Germany by Messrs. Meister, Lucius and Bruning, of Höchst, was said to contain 10 milligrammes of solid substance to every 1 c.c. This was incorrect. Though 10 milligrammes of tubercle bacilli are used in its preparation, each 1 c.c. of the finished product contains only 2 *milligrammes of tubercle powder*. Hence, the nomenclature of dosage needs correction, and what has been called $\frac{1}{10000}$ milligramme is in reality $\frac{1}{5000}$ *milligramme of tubercle powder*. This correction must be applied to all English and German literature where this preparation has been used. The *bacillary emulsion*, on the other hand, suffers no loss during its preparation, and really contains in each 1 c.c. the 5 milligrammes of solid substance from which it was manufactured.

toys; *thirdly*, there is a tendency to *local healing*. If any of these are lacking there is need for revision of dosage. Often the local lesion improves, even to healing, after the first injection, but there is generally a relapse, and several inoculations are necessary to complete the cure. It must also be remembered that in "surgical" tuberculosis of children there is nearly always a "primary focus" to be considered. This is generally situated in the thoracic glands, and treatment should be continued sufficiently long to allow this a chance of healing.

As examples of localized tuberculosis in children may be mentioned tuberculous dactylitis and superficial tuberculous abscess, which are very suitable for this method of treatment; tuberculous glands, where improvement is somewhat slow but sure; joint disease, which needs much patience. If cases can be taken early surgical measures may be avoided; often the treatment must be combined with surgical help, and in cases where caseous material is present in quantity it should, if possible, be surgically removed. Operations should be arranged to correspond with the high-tide of opsonic power.

2. Cases of *less localized tuberculosis* (*i.e.*, accompanied by general symptoms) must be treated on rational lines. The indications are—first to suspend auto-inoculation by rest and by increasing the coagulability of the blood (Wright); afterwards to treat on the lines already laid down. In tuberculous peritonitis I have obtained considerable success, and I consider this one of the most suitable forms of tuberculosis for tuberculin treatment. Cases occur, nevertheless, in which no improvement is obtained, and in such it may be worth while trying the Perlsucht-tuberculin (P.T.R.), since it has been shown (A. Weber[1]) that the bovine bacillus is the cause of more than half the cases of abdominal tuberculosis in children. In phthisis I have had some success from the scientific method of tuberculin treatment, but only one of my patients was a child.

3. The principal contra-indication to the use of tuberculin by the older method was the presence of *secondary infections*. This is by no means the case with the method now under description. It must be borne in mind that open tuberculous lesions soon become the home of other organisms, mainly staphylococci and streptococci (56 per cent. and 44 per cent. respectively, Petroff[2]), and it has been shown that the dissemination of tubercle is accelerated by the presence of a mixed infection. In wide and inaccessible lesions, moreover, a condition of sapræmic poisoning is kept up, which largely contributes to the downward course of the case.

These secondary infections I have seen largely ameliorated, and in

[1] Weber: "Untersuchungen über Tuberkelbazillen verschiedener Herkunft," *Tuberkulose Arbeiten*, Heft vi. 1907.

[2] Petroff: "L'infection mixte dans la tuberculose chirurgicale," *Annales de l'Inst. Pasteur*, vol. xviii., p. 502. 1904.

some cases, cured by the use of tuberculin alone; occasionally the preparation of a second vaccine becomes necessary.

At the conclusion one should speak of "contra-indications," but if the system has been thoroughly understood there will be no difficulty in deciding where it is applicable. It must be borne in mind that the vaccines are in no sense "emergency" preparations. Their success depends on a power of response on the part of the patient, and where this is absent, as with cachexia, advanced disease, or approaching death, no good, but only harm, will attend their use.

Recently Arthur Latham[1] has shown reasons for believing that tuberculin and other vaccines are absorbed sufficiently readily from the alimentary canal to be successfully administered *per os*. Tuberculin given by the mouth together with either normal saline solution or fresh horse serum appears to him to produce a tuberculo-opsonic vaccination curve. If his contention is proved, the administration of tuberculin will be greatly simplified, but one cannot help fearing that, under the varying factors of alimentary absorption, accurate dosage will be impossible to obtain.

Serum Treatment of Tuberculosis in Children.

The applicability of serum treatment to tuberculosis depends on a belief in the formation of anti-bacterial substances other than opsonins in response to "vaccination." This is denied by many, and Wright holds that the anti-tuberculous sera act as vaccines only. Serum treatment began with the injection of blood or serum from naturally immune animals (dogs and goats); later artificially immunized animals were used—asses and sheep by Prudeau and Baldwin, horses, mules, and asses by De Schweinitz—but without success. At the present time two anti-tuberculous sera deserve some notice:

Maragliano's serum (1895) is obtained from horses and cattle by immunization with a filtrate of virulent young bacilli mixed with an extract of virulent dead bacilli. The serum is protective to rabbits and guinea-pigs (Ravenel[2]), but its clinical value is doubtful. Many Italians, however, have spoken well of it, and Mircoli described its use in 2,899 cases with good results.

Marmorek's serum (1903) is produced by the injection of horses with bacilli grown on media designed to imitate the conditions present in the human body; Marmorek holds that the true toxin of the tubercle bacillus is not produced on ordinary culture media. The clinical results

[1] Latham, A.: "Preliminary Communication on the Administration of Tuberculin (T.R.) and other Vaccines by the Mouth, together with (*a*) Normal Saline Solution; (*b*) Fresh Horse Serum," *Proc. of Roy. Soc. of Medicine* (*Med. Section*), vol. i., p. 195. 1908.

[2] Ravenel: "Maragliano's Method of producing a Specific Serum for Treatment of Tuberculosis and of Vaccinating against Tuberculosis," *Veterinary Journal*, vol. xiv., p. 36. 1907.

obtained with this, as with Maragliano's serum, are various and doubtful. At the beginning its continuous injection led to serious cases of "serum disease"; but this difficulty was overcome by the introduction by Frey of Davos and Mannheim of Berlin of the method of rectal administration. It appears from the literature that most benefit has been derived in "surgical tuberculosis" and early phthisis (Hyman and Daniels,[1] van Huellen,[2] Hoffa). Monod[3] says that five authors, with 39 cases, speak against the serum, and thirty-eight authors, with 592 cases, in its favour. He concludes that it is harmless, may be used in all sorts of cases, cures early surgical tuberculosis, and improves phthisis. For the latter disease a *sérum double* is recommended, which is anti-streptococcic as well as anti-tuberculous.

[1] Hyman and Daniels: "Ueber die Behandlung der Tuberkulose mit Marmorek'schem Serum," *Berlin. Klinische Wochenschr.*, vol. xliv., p. 1554. 1907.

[2] van Huellen and Hoffa: Discussion über Marmorek's Vortrag "Ueber neue Tuberkuloseforschungen," *Deutsch. Medic. Wochenschr.*, vol. xxiii., p. 865. 1907.

[3] Monod: "Sur la sérothérapie dans la tuberculose," *Bull. de l'Acad. de Médic.*, vol. lvii., p. 122. 1907.

XXXVI.

THE HYGIENE OF THE NURSERY IN RELATION TO TUBERCULOSIS.

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Among the many diseases of child-life there is none that in fatality and morbidity approaches tuberculosis. The gravity of this scourge is not to be reckoned only by the number of deaths it causes, but also by its crippling and incapacitating power.

Pre-natal Influences and Tuberculosis.

The condition of the woman during pregnancy has an undoubted effect on her unborn child. Children seldom come into the world with distinctive signs and symptoms of tuberculous disease. It is certainly rare for the tubercle bacillus to gain access to the blood-stream, and therefore rare for it to be conveyed through the medium of the placenta to the fœtus. Tuberculous lesions are, however, frequently seen in infants a few months old, and most frequently in the delicate offspring of tuberculous mothers. This favours the hypothesis that unborn children are affected by the toxins circulating in their mothers' blood and conveyed to them by the placenta, and thus a favourable soil is prepared for the cultivation of the tubercle bacillus.

Great care should be taken in selecting healthy and vigorous young people for the sacred duty of continuing the race, and a well-instructed public opinion must be formed to ensure that the marriage of sickly and unsuitable people shall be reprobated and hindered, not easily condoned as at present. The expecting mother must have an ample supply of good and nourishing food, she must have plenty of fresh air and exercise, and should sleep in an airy, well-ventilated room; her clothing should be light, warm, and suitable; for everything that promotes the health and well-being of the expectant mother has a favourable influence on the unborn child.

The Protection of the Infant from Tuberculous Infection.

The great majority of mothers are sincerely anxious to do the best that lies in their power for their little ones, but, unfortunately, most of them are absolutely ignorant of the commonest necessities for the welfare of children. In too many of the town nurseries of wealthy families we find the sanitation of the nursery very defective, while the furniture and other appointments are unsuitably luxurious. It is only in the case of people of easy means that anything approaching an ideal nursery can be had, but it is well that people should know what are the ideal requirements, so that they may approach as near to them as is possible.

A Non-Tuberculous Nursery.

The ideal nursery would naturally be found in a country house situated on the side of a hill, protected from the north and east either by rising ground or by trees, while the windows should face the south and west in order to enjoy the maximum of sunlight. Children, like flowers, are especially susceptible to the influences of direct sunlight and of fresh air. The access of direct sunlight is very important, not only for its vivifying and stimulating effect on the children, but also because sunlight is particularly inimical to the growth of the bacillus of tubercle. If this had been thoroughly appreciated at the time many of our houses were built, we should not find interminable corridors into which no ray of direct sunlight ever penetrates. Every room inhabited by children ought to be flooded with sunlight from early in the morning until sunset, with, however, some provision for screening off the direct rays of the sun in the middle of the day during the hottest months. The windows of the nursery ought to be the ordinary sash windows. A French window is much prettier—it is delightful to pass through the open window into the garden or on to a balcony—but it is much more difficult to regulate the access of air through such windows; and in a climate such as ours they would certainly be shut through the greater part of the day during the winter months.

It is a good thing to have some provision whereby the two parts of the sash may be made to overlap. This can be done by a board adapted to the lower part of the window, so that when the weather is bad the air can still pass in between the overlapping sashes without any direct draught flowing into the room. During very foggy weather the space left by the overlapping sashes should be filled with cotton-wool, which filters the air as it comes in. The dirty condition of the wool after a short exposure to foggy air would convince anyone of the great desirability of straining the air which the children are to breathe.

Another point of importance with regard to windows is to make sure that they do not admit noxious fumes, such as come from factories

and stables. In large towns it is, of course, almost impossible to secure so high a standard of air as could be obtained in the country; and in those cases where it is difficult to secure windows not overlooking mews, stables, and other insanitary premises, the plan of filling the interspace between the sashes with cotton-wool is particularly desirable.

Children require fresh air, but fresh air does not mean a draught. Care must therefore be taken that the window shall not be so placed with reference to doors and fireplace that the child must necessarily live in a river of cold air flowing between the inlet and outlet of ventilation.

Furnishing of the Nursery.

The furnishing of the nursery cannot be too simple. The present fashion of having everything white and polished is a particularly good one, not only because it secures the maximum amount of brightness and illumination, but also because any soiling and deposit of dirt is more easily detected. The walls and the ceiling should be either white or some light tint, the surface being such as admits of washing—*e.g.*, the walls should be finished in enamel, or in poorer houses the paper should be varnished. In this connection it ought to be remembered that pictures are veritable traps for dirt and dust, and that their frames ought to be wiped over with a damp cloth once a day.

What children want in their nursery is plenty of space in which to move about. They do not desire or need heavy and expensive furniture. One strong table, on which certain games can be played and which serves for meals, is necessary; beyond this there should be nothing but cupboards in the walls for the toys, one or two comfortable chairs for the nurse, and small chairs for the little people. The present arrangement of what are called "casement" curtains—short and readily drawing backwards and forwards—is much to be preferred to the long curtains which sweep the floor, and in the folds of which so much dirt always lurks. The practice of hanging children's rooms, either day nursery or night nursery, with woollen curtains or curtains of a dark material, is a great mistake. Woollen fabrics harbour dust and infection, and dark-coloured material prevents the ready detection of these undesirable visitors.

The floor should be covered with cork lino, and there should be a few rugs on which the children can sit to play, the rugs being small enough to be carried away and shaken in the open air every morning.

The Hygiene of the Night Nursery.

The night nursery should be large and airy, the windows should be open night and day, but the beds should be placed out of the draught, and, if necessary, protected during the night by screens. The beds

themselves are best made of iron painted white, with horsehair mattresses and soft blankets. In the case of delicate children it is better to dispense with sheets, although a little fold of linen may be tacked along the upper edge of the blanket if the child objects to the feeling of the woolly blanket against its face. Nowadays it is surely unnecessary to say that bed-curtains should not be used. The child should lie with its head low, having only one small pillow, and care should be taken that it does not lie always on the same side, for a child that lies always on one side is certain to grow unsymmetrical, one side of the face being different from the other, and the spine more or less curved.

Many parents prefer Jaeger bed-clothing for their children; it is certainly very nice, but not essential. Any good woollen material suffices, and few things can equal in warmth and lightness combined the best quality of Witney blankets. Heavy quilts and counterpanes should be discarded, the blankets being covered with a simple cotton coverlet to protect them from dust. The bed should be stripped daily, the bed-clothing hung up to air, and the mattresses themselves exposed to sunshine and air in the summer, and aired before the fire in the winter. Children's bedding needs to be frequently remade or cleaned, and great care must be exercised, especially in the case of little children, to prevent any wetting or soiling of the mattress; this is easily done by a sheet of waterproof cloth being laid between the mattress and the under blanket.

Clothing for Children.

With regard to clothing, even in these advanced days, and with an enormous variety of suitable materials and most excellent patterns, the odd thing is that the majority of children continue to be badly clothed. Some of them are most distinctly overclothed, and this mistake is probably more often committed by the poor than by the rich. Little ones are often sent to school with some ten or twelve garments piled one on the top of the other, and surmounted by a ragged comforter wound about the neck! In other cases the clothing may or may not be excessive taken as a whole, but it is heaped upon parts of the body, while other parts which equally need protection are left naked. Formerly arms, necks, and legs were considered prettier uncovered, and truly nothing is more lovely than the rounded contour of infantile limbs; but there are few things that more rapidly lower vitality, and therefore that more certainly prepare the way for the inroads of tuberculosis, than the depression which is caused by insufficient, badly arranged, and unsuitable clothing.

The whole of children's bodies and limbs should be covered, and that covering should consist of fine, soft, woollen material. Each

article of clothing should be light and thin, and there should be three, or perhaps four, layers superimposed, because air is the best of non-conductors; and, therefore, two or three thin woollen garments keep the body more equably warm than one or two garments of much greater thickness. It is also to be remembered that children's muscles are easily tired, and that they are not adapted for the carrying of a great weight of clothing.

The infant should have a soft little vest of Shetland or some other fine wool; over this its long flannel, which, however, should not extend far below the feet; then a thin woollen garment, made more or less prettily according to the means and the fancy of the child's mother.

Little children from about two years of age can all wear the soft undervest, next a flannel garment which may be called shirt or chemise according to fancy; after this, knickers attached to a strong bodice, and a short tunic reaching to the knees. The legs must be defended with warm woollen stockings and stout shoes, to which woollen gaiters should be added when the child goes out. It is a great mistake to dress little girls in a quantity of petticoats; they get sadly into their way when scrambling and climbing, and not only lead to sprains, dislocations, and fractures, but by preventing healthy exercise of the whole body they depress the child's vitality and render it less able to carry on the warfare against tuberculosis and all other germ diseases.

The head-gear of little children, unfortunately, generally leaves much to be desired. Children are sent out in the hot sun with most flimsy and inadequate hats, or sometimes without any hats at all. Substantial straw hats, with folds of white muslin or white net round them to protect the head from the sun, are a good form of head-gear for use in temperate climates.

Anti-Tuberculous Food.

The only proper food for infants is their mother's milk, and it is absolutely necessary that doctors, nurses, and sanitarians should make it a matter of conscience to instruct mothers in their duties in this respect. It has been our fault in the past that women have imbibed the erroneous and dangerous idea that bottle-feeding is as good for the child and far less trouble to the mother. The difference of the birth-rate between the bottle-fed and the breast-fed infant ought to convince us of the fatal error we make in permitting infants to be brought up on any substitute for their natural food. The cases are very few in which women cannot nurse their children with positive advantage to their own health. In the majority of cases all that is needed is common sense and perseverance on the part of doctor, nurse, and mother, together with a skilful adaptation of the woman's food to the end in view. The nursing mother should be advised to give up all stimulants

and all indigestible and innutritious food, and to take a large quantity of milk—*e.g.*, about a quart daily—in addition to three good meals (morning, midday, and evening). If she will do this, and avoid excitement and late hours, she will probably find that she has an abundance of good milk, and that her own health attains an unusual standard of excellence.

There is an old saying that a woman should carry her child nine months and should suckle it nine months; in the majority of cases, when the child is from eight to nine months old, one or two meals of cow's milk, either diluted or undiluted according to the vigour of the child, may be added to the food the mother is able to provide. Up to the age of two years milk should be the great staple of a child's diet, supplemented towards the end of that time with a sufficiency of bread and butter, potato and butter, milk puddings, and a little green vegetable. Meat is better postponed until after the completion of the second year, and even then must be given in very small quantities.

Little children, like their elders, have their peculiarities, and the same diet will not succeed in all cases, nor in the same child under all circumstances. It is, however, absolutely essential to avoid dyspepsia and gastric catarrh. The child who does not digest and assimilate well quickly becomes pale, feeble, and badly grown; if to this is added catarrh of the stomach and bowels, the onset of tuberculosis is probably near at hand.

We have to thoroughly convince, not only ourselves, but also the nation at large, that all injured organs and tissues afford a soil only too well prepared for the cultivation of micro-organisms. Thus we find in the swollen tonsils and congested throat the most frequent sites of entry of the tubercle bacillus, just as they are a ready breeding-ground of the diphtheria bacillus. In the stomach irritated and congested by unsuitable food, the healthy acid secretion of which is in abeyance, we find many pathogenic organisms, while the disordered intestine, with its perverted secretion, is simply a paradise for armies of these deadly invaders.

It is a disgrace to our nation, both to our business capacity and to our sense of fair-play, that we should still permit the dairy-farmers and the railway officials between them to inflict upon the large towns of the kingdom milk that has in many instances been fouled before it leaves the dairies, and which has greatly deteriorated by the unnecessary violence with which it is treated during the journey. Even worse than this is the fact that in the great majority of instances the milk-cans are neither sealed down nor padlocked before leaving the dairy, their covers are liable to be displaced, and the contents are fouled by engine dirt, dust, and flies, both during transit and after it leaves the care of the railway company. The storage of milk is not understood, and,

especially in small shops, it stands about in open vessels, absolutely unprotected. The consequence is that the milk which reaches the house of the town consumer is frequently not only acid in reaction from the action of the micro-organism which causes the formation of lactic acid, but it is also visibly fouled by flies and other extraneous matter. Cooks and nurses are no better than the dairy-farmers and the railway companies; they treat the milk with scanty respect, and it is too often left about uncovered and kept in airless cupboards or in hot kitchens, when it ought to be standing on ice and carefully covered from dust and dirt.

One feels quite reluctant to write of all the horrors connected with children's food, of the unnecessary fouling of the health-giving fluid—the milk—of the dirty water with which it is too often mixed, and the abominable bottles with long tubes which have caused the death of so many little ones. It is an absolute impossibility to keep these long tubes clean; small clots of milk remain in them, and in these clots the micro-organisms breed, and are constantly sucked in by the child with each fresh supply of milk. The only proper sort of bottle is the boat-shaped bottle, which has an aperture at each end, so that not only can it be boiled, but a stream of running water can pass through it and a suitable brush can be drawn right through so as to cleanse every part. The teats should be of indiarubber; they must be boiled after each meal, and then kept in cold boiled water.

As a matter of fact, the precautions necessary to secure that the child's milk is pure and wholesome are exceedingly simple, and not costly. Pure milk and uncontaminated milk administered in suitable bottles should be within the reach of all children, and it is nothing but our apathy and our ignorance that prevents so easy and desirable a reform.

Hygienic Perambulators.

A few words must be said with regard to children's perambulators and mail-carts. There are many excellent patterns in which the child can either lie or sit, with adequate protection from wind, rain, and sun; but there are other patterns on the market which are absolutely unfit for little children. These objectionable perambulators have somewhat the appearance of very frail, unserviceable chairs mounted on rickety wheels. In these machines the poor little child has no protection from the weather, its spine is never at rest, the attitude being neither one of lying nor of well-supported sitting; they are thoroughly untrustworthy and even dangerous.

Even in the best of mail-carts it is sometimes forgotten that very young and delicate infants require additional warmth, and that a large hot-water bottle ought to be placed in the baby-carriage, although far from immediate contact with the child's person.

The Health of Children's Nurses and Attendants.

The attendants in charge of children should be very carefully selected. To begin with, they should be themselves in perfect health, partly because it is only people in a good physical state who are likely to have the necessary patience and brightness for the satisfactory rearing of children; but still more because any illness involving discharge, such as chronic catarrh of the air-passages, or consumption, and other open forms of tuberculosis, are a very serious menace to the little ones under their care. Many people, even those who are well brought up, and who might be expected to know better, do not consider what highly infectious fluids are saliva and nasal discharge. How frequently we see a nurse, or even a governess, using her own handkerchief for the child, or tasting the child's food and then feeding the little one with the same spoon! Only the other day, at a certain day-nursery, a good, kind-hearted nurse was seen sitting in a circle of a dozen children whom she was feeding with one spoon out of a bowl of bread and milk!

It cannot be too widely known that as soon as nasal catarrh or expectoration becomes dry the infectious particles that may possibly be present are wafted about by currents of air, with the necessary result of carrying infection to food and to all people in the immediate neighbourhood. Little children more than adult human beings afford an excellent breeding-ground for micro-organisms, and therefore we find that in crowded dwellings, and amongst people who are inattentive to the details of sanitation, much infection of children occurs.

In this necessarily condensed presentation of a very extensive subject little has been atttempted beyond a bare setting forth of the unsavoury facts connected with tuberculosis in children and the making of a few suggestions as to how this danger may be avoided; but, imperfect though this chapter may be, it will not have been written in vain if it leads those who read it to a wider investigation into this most important subject, and into a conscientious endeavour to wake up the minds of those who have the care of children to one of the greatest dangers to which these important little people are exposed.

XXXVII.

TUBERCULOSIS AMONG LONDON CHILDREN OF SCHOOL AGE.

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That tuberculosis among children of school age is far from uncommon in London is unfortunately evident to all who visit our hospitals. To express the extent of this prevalence in figures is almost impossible, though there are statistics which would justify the supposition that something like 30 per cent. of children of this age may be tuberculous.

Tuberculosis is not a notifiable complaint, and the death-rate from this disease between the ages of five and fifteen years is no measure of the number of sufferers between these ages. Tuberculosis of bones and joints—a form of the disease which is especially prevalent in childhood—does not generally lead to a fatal result, or, at least, does not do so directly or quickly. Glandular tuberculosis, also common in childhood, frequently ends in partial and complete recovery.

Mortality Returns.

According to the Registrar-General's last decennial report, the average number of deaths from all forms of tuberculosis during the age-periods of five to fifteen years in London amounted to about 600 per annum; and if we multiply this by ten—a not excessive estimate of the proportion of non-fatal to fatal cases—we get 6,000 children of school age suffering from serious tuberculosis in the metropolis. Possibly 10,000 would be nearer the mark if slighter cases were included.

This is, after all, only a rough estimate, but it indicates the large number of children suffering from tuberculous disease.

Predisposing Conditions.

Tuberculosis, though it spares no class of the community, is more especially a disease of poverty. The concomitant conditions of poverty —overcrowding, dirt, insufficient or improper food, the general want of proper hygienic and sanitary needs in the home—these are amongst the most potent causes predisposing to this disease, the infective germs of which are omnipresent in large cities. Thus the children of the poor suffer in greater proportion than the children of the well-to-do.

The Prevalence of Tuberculosis in Metropolitan Schools.

Tuberculosis may, therefore, be expected to be a very prevalent disease amongst the children who attend the elementary schools. Endeavours have been made to obtain some estimate of the actual numbers of tuberculous children on the roll of the Council schools, and in the report of the Medical Officer (Education) to the Education Committee of the London County Council for the year 1907 there are some interesting returns dealing with this subject. One series of inquiries was made by Dr. Annie Gowdey and myself, which was mainly directed to the prevalence of pulmonary tuberculosis ;[1] another inquiry, undertaken by Mr. R. C. Elmslie,[2] was chiefly concerned with the prevalence of tuberculosis of the spine, hip, knee, and other forms of surgical tuberculosis.

In a general survey of the question of tuberculosis in school-children there are two main directions in which the subject has to be considered. There is, first, the number of children affected, and the best way of treating these ; and, secondly, the possible danger to other children attending school from the presence amongst them of the subjects of tuberculosis. The treatment of tuberculous children is of immense importance in view of the terrible amount of incapacity from deformity or permanent ill-health which results in adult life from tuberculosis in childhood. The early cure of those who become affected, the prevention of infection in the susceptible and the counteracting of predisposition, important as these considerations are in the adult, are doubly important in the case of children.

Active Tuberculosis.

Dr. Kerr[3] pointed out years ago that, amongst the children attending the ordinary elementary schcols, there are comparatively few suffering from active tuberculosis, and extremely few who, because of "open" tuberculosis, are a danger to others. It is not in the school that we

[1] Squire, J. E., and Gowdey, A. : "Pulmonary Tuberculosis in Elementary Schools," Proceedings of International Congress on School Hygiene. London, 1907.

[2] Elmslie, R. C. : "Report of Medical Officer (Education), London County Council, for the year ended March 31, 1907."

[3] Kerr, J. : "Tuberculosis in Elementary Schools," *Tuberculosis*, July, 1900.

must look for the cases of active tuberculosis, but in the homes; and it is in the home also, and not in the school, that children are exposed to infection from tuberculous children and adults.

Special Schools for Tuberculous Children.

Children with active tuberculosis, whether of lungs, bones, or joints, who are not too ill to attend school, are in London sent to the special invalid schools (schools for physically defective children), where also are to be found those who are crippled or deformed from past tuberculous disease of spine or joints. Even in these schools no cases of "open" tuberculosis—whether pulmonary tuberculosis with expectoration, or surgical tuberculosis with discharging wounds—are allowed to attend.

Prevalence of Pulmonary Tuberculosis in London School-Children.

In my investigation with Miss Gowdey we found that, amongst 60,000 children, about 1 per cent. were supposed by the teachers or parents to be suffering from some form of tuberculosis, and, in addition, rather more than this were absent from school (though on the roll) because of this disease. Careful examination of the children at certain selected schools showed, however, that (as we expected) these estimates were altogether unreliable, most of the children returned as tuberculous showing no evidence of this disease, whilst evidence of the disease was found in others in whom there had been no suspicion of tuberculosis Our examination showed pulmonary tuberculosis in only 0·5 per cent. of the children in attendance.[1] This proportion agrees very closely with the result of a similar inquiry in the schools at Brighton; but the proportion of cases of pulmonary tuberculosis amongst school-children in various parts of the kingdom, given in different articles and reports, varies enormously (from 0·5 per cent. to 6·7 per cent.) Several of these reports deal with small numbers of children, and not always unselected groups; nor has the examination always been carried out by experts in chest examination—an important consideration when we bear in mind the special difficulties in the physical diagnosis of lung conditions in children.

Surgical Tuberculosis.

Turning to the cases of surgical tuberculosis; there are under the London County Council Education Department twenty-three invalid schools, with approximately 1,802 children on the roll, of whom a large proportion apparently—somewhat over 50 per cent.—are suffering from tuberculosis and its results; but these represent but a small proportion

[1] Squire, J. E.: "Tuberculosis among Children in the Elementary Schools of London," *British Journal of Tuberculosis*, p. 225, July, 1907.

of the children of school age suffering from surgical tuberculosis and its effects. The prevalence of tuberculosis amongst children of school age may be summed up by saying that, though unable to express it in exact figures, there is clear evidence that the disease is sufficiently prevalent to constitute a danger to the community, and to justify some comprehensive and systematic attempt at cure and prevention amongst the children who attend or should attend the elementary schools.

Practical Considerations.

When reviewing what is already being done in this direction, the conclusion is inevitable that as yet little or nothing has been accomplished, and that this country is behind its Continental neighbours in provision for the care of tuberculous school-children. The requirements include hospitals or sanatoria for the cases of active tuberculosis, with provision for instruction for the children, who from the slow progress of the disease may need to be under treatment for months or even years.

At present provision is made for the instruction of tuberculous children in some of the special children's hospitals (*e.g.*, the Alexandra Hospital for Hip Disease in Queen's Square), but there is need for special curative institutions in the country under the Education Committees of the Local Authorities.

Another necessity is country or seaside schools for London children who, though not actually (or actively) tuberculous, are yet specially predisposed by reason of ill-health, where children might be sent for a few weeks or months as required. As the result of the provision in the above directions which the Paris Municipality has had at work for some years, the mortality from tuberculosis in children is said to have diminished considerably.

A further requirement is for open-air schools in or near London, which can be reached by tram by the children of some of the poorer and most crowded parts. One such school has been established by the London County Council for the Woolwich and Greenwich district. Some portion of the parks and open spaces could be utilized for school-work in the summer months without inconvenience to the general public, and in nearly all schools the playgrounds might be made use of for class-work during the fine weather.

Beyond these school requirements it is essential that the care of the children in their own homes should be insured as far as possible. It is difficult at present to obtain any influence over the hygienic arrangements of the home; yet the medical inspection of school-children will fall short of what is desirable in practical results if the home conditions of the children cannot be brought under the influence of the public

authority when, as so often happens, the child's school advantages are counteracted by unhygienic conditions at home.

Something may be done by the teaching of domestic hygiene in the schools, but this will tell on the future generations rather than on the present.

Many of the tuberculous children, and most of the dangerous cases amongst these, remain at home, being too ill to attend school. It is, therefore, very necessary to be able to exercise hygienic control in their homes. Notification of all cases of tuberculosis seems to be an essential preliminary.

As a further preventive measure arrangements might be made for boarding out London children in country villages, where they could attend school during their stay. Relays of children, each staying a month in the country, would enable a large number to get the advantage of a change of air and scene every year with benefit to their health and enlargement of their mental outlook. Careful supervision of such boarded-out children should be provided for to prevent them infecting —morally as well as physically—the country children with whom they must associate.

Available Provisions for Tuberculous Metropolitan Children.

The present provision for tuberculous children of school age in London may be thus summarized:

For Cases of Active Disease.—Children are admitted to the children's hospitals and to the consumption hospitals and sanatoria; in only a very small proportion of the cases is any provision made for education to be carried on whilst undergoing treatment. There is a home for consumptive children (Millfield Home, near Littlehampton) under the Metropolitan Asylums Board.

For Cases of Slight or Arrested Disease.—The Council's Invalid Schools.[1]

For Preventive Treatment.—The Council's open-air school at Bostall Wood.

The Children's Holiday Fund Organization, by means of which change of air and scene may be obtained during the holidays, also renders valuable additional help.

There are also certain convalescent homes and similar institutions where delicate children may get a month's fresh air; these, like the hospitals, are in no way directly connected with the Education Authority, and in most of them there is no provision for continuing the

[1] A list of these is given in Board of Education Blue-Book, "List of Certified Schools for Blind, Deaf, and Defective Children in England and Wales, on August 1, 1907." Price 2½d. London, 1908.

children's education during their stay. The influence, however, of these institutions in the prevention of tuberculosis cannot be overlooked.

It cannot be said that there is as yet any adequate provision under the Education Authority of London either for the treatment of tuberculous school-children or for the prevention of tuberculosis amongst the children attending school. Such is greatly to be desired.

XXXVIII.

SCHOOL HYGIENE AND MEDICAL INSPECTION IN RELATION TO TUBERCULOSIS IN CHILDREN.

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AND

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In the following article an endeavour has been made to illustrate by the concrete practice of Scotland the general principles of School Hygiene, Medical Inspection of School-Children, and the Instruction of Teachers. This seems likely to be of more service than a sketch of possible, but unrealized, schemes would be.

Mr. A. J. Bain, of the Local Government Board for Scotland, has rendered much service by preparing and checking most of the statistics here presented.

Prevalence of Tuberculosis among School-Children.

The data for an estimate of the prevalence of tuberculosis among Scottish school-children are as yet very inadequate. The figures we are able to give are to be taken rather as a rough justification for further investigation than as a basis for general conclusions. It is not that multitudes of children have not been examined; but it is that the school child, as such, has not been considered, particularly from the tuberculosis standpoint.

1. For Scotland as a whole, let us look at the deaths for the last thirty years. We have selected the deaths of children aged four to five, five to ten, and ten to fifteen. This does not coincide exactly with the school age, which is from five to fourteen; but as the school

rolls always contain a large number over four and under five and a large number over fourteen, the progress of the deaths at ages four to fifteen will be an index of school prevalence. And, as only approximations are possible, we may content ourselves with five-yearly averages. If, then, we take the yearly average for five-yearly periods from 1876 onwards—that is, four years after the passing of the great Education Act—we find as follows:

First, *phthisis:* Average male deaths, 380, 305, 257, 212, 177, 161; female deaths, 518, 467, 422, 386, 341, 314; total deaths, 898, 772, 679, 598, 518, 475. There is a decline both among males and females. The decline is much greater than the crude figures show, for the population has steadily increased. It is not possible to give with any exactness the school populations for the earlier years, but the crude decreases are sufficiently striking.

Second, *other forms of tuberculosis:* Average male deaths, 519, 429, 387, 351, 359, 410; female deaths, 432, 421, 390, 366, 383, 413; total deaths, 951, 850, 778, 717, 742, 823. Here there are indications of a distinct increase in the last five-yearly period. This may in part be due to the new nomenclature, which was adopted by the Registrar-General from the year 1901 onwards. But this does not account for the whole facts; for, if we take the last five years—that is, the five years of the new nomenclature—we find that the phthisis male deaths were 144, 179, 148, 164, 171; female deaths, 327, 308, 288, 346, 302; totals, 471, 487, 437, 510, 473. The other-forms-of-tuberculosis deaths were: Males, 380, 376, 423, 445, 427; females, 391, 372, 403, 477, 422; totals, 771, 748, 825, 922, 849. Possibly, diagnosis has been growing more exact; more attention has been given to school-children; the whole medical and lay world has been learning to look for tuberculosis, and a little more of it has been found. The increase has been diffused with fair uniformity over the whole school ages, which confirms the view that the increase is an increase of cases discovered, not an increase of cases caused.

The children on the school registers for the years 1902 to 1905 were as follows: 768, 528; 785, 473; 793, 492; 804, 162. With the deaths given above, these populations yield death-rates per 1,000 of—(*a*) *phthisis*, 0·63, 0·56, 0·64, 0·59; (*b*) *all forms, including phthisis*, 1·61, 1·61, 1·80, 1·64.

2. In Edinburgh, for the years 1901 to 1905, the phthisis death-rates at ages five to ten and ten to fifteen (excluding ages four to five) per 10,000 children living were: 2·9, 3·0, 3·3, 2·8, 3·2. The populations (estimated) were: 66,003, 59,618, 60,437, 61,315, 62,165. The drop between 1901 and 1902 is due to the census. These populations include much more than the Board school children, who ranged only from 30,000 to 36,000, the non-Board schools having the rest.

3. Of 675 cases of phthisis notified in Edinburgh during part of the first year of compulsory notification, only 25 were persons under fourteen years of age.

4. At the Edinburgh Royal Victoria Dispensary for Consumption the following are the numbers for the years 1904 to 1907: Cases examined (ages over five, under fifteen), 158, 169, 182, 203; found to be genuine tuberculous phthisis, 116, 128, 117, 126; cases aged five to ten, 41, 46, 46, 48; aged ten to fifteen, 75, 82, 71, 78. That is, out of 712 cases examined, 68·4 per cent. were really phthisis. The presumption is that the other cases were also suspected to be phthisis; but only 68·4 per cent. were verified by bacteriological examination. For the years in question (1904 to 1907) the School Board school population may be taken as approximately 36,000. If we take the average cases for a year as 122, this population gives a case-rate of 3·1 per 1,000. But this figure cannot be taken as representative, since only a percentage of cases go to the dispensary. The figure shows, however, that the true number must be well over 3 per 1,000, and, as Edinburgh stands rather low in the general phthisis death-rate, we may regard the Edinburgh figure as well below the fact for other large towns.

5. In the Edinburgh investigation for the Royal Commission on Physical Training (Scotland),[1] 14 cases were found in 600 children chosen by lot—the large percentage of 2·3, or 23 per 1,000. In the later investigation of an Edinburgh selected school in a poor quarter the percentage of phthisis in 1,319 children examined was 1·44.[2] (In the same number, the percentage of bronchitis was 2·20, and of bronchial catarrh 1·21. This is important. Possibly some forms of infantile bronchitis mask tuberculosis. Dr. Philip takes this view.) Probably the earlier figure (2·3 per cent.) was an error of small numbers. The later figure (1·44 per cent.) is much more likely to be representative even of the poorer quarters.

In Aberdeen[3] (600 examined) only 3 cases of consolidated apex were found—that is, 0·5 per cent. But, again. this is probably an error of small numbers, and there were some grounds for believing that the sampling of the schools was less representative than in Edinburgh.

In these school investigations, the examination was limited to what was possible at school—physical signs and symptoms. None of the cases were verified by bacteriological examination. Allowance must, therefore, be made for non-tuberculous consolidations; but, whenever

[1] "Royal Commission, Physical Training (Scotland) Report, 1903."
[2] "Report on the Physical Condition of 1,400 School-Children." Edinburgh: C.O.S. London: P. S. King and Son. 1906.
[3] "Royal Commission, Physical Training (Scotland) Report, 1903."

possible, the child got the benefit of the doubt, and only the marked cases were recorded.

6. But the probable prevalence of tuberculosis is not to be decided on such facts alone. Vast numbers of enlarged glands were found, some certainly tuberculous. Bronchitis we have already mentioned. Enlarged tonsils and adenoids were numerous. Malnutrition of every grade was common. Thus, many morbid conditions strongly predisposing to tuberculosis were present in a large number of children. All these point to the probable existence of "latent" tuberculosis, an unfortunate term meaning "active" tuberculosis, but not as yet to be diagnosed by ordinary clinical methods. (The word "latent" should be dropped; it is ambiguous.)

7. In Glasgow (750 children) only 2 cases of phthisis are specifically described; but this was not regarded as the total.[1]

8. In Dundee, 517 boys and 539 girls were examined. Among the boys, "63 cases of lung affections were found," all, except one, cases of bronchitis or bronchial catarrh. "No phthisis was diagnosed, although some of the cases were probably tubercular." Among the girls were found 20 cases of "consolidation or impairment of apex, one or other," 3 cases of "weak breath-sounds," and 12 cases of bronchitis. Two of the cases discovered were "tubercular and in a critical state." These are large percentages. If we assume that 20 cases among girls were tuberculous, we get a rate of 3·7 per cent.[2]

9. In Dunfermline, the experience has been somewhat similar to Aberdeen. In 1906[3] no cases of phthisis were discovered among 1,371 boys examined; but there were 9 cases of "breath-sounds deficient in certain areas." Among 323 girls examined, there were 6 cases of "breath-sounds deficient." In the report for 1907 the figures were: boys, 30 in 1,068 examined; girls, 2 in 428 examined.

10. In Leith (808 children examined) 0·74 per cent. were found with phthisis.[4]

11. The Medical Officer of Schools, Edinburgh, has found, among 710 children referred to him on account of some ailment, 60 cases of phthisis—*i.e.*, 8·45 per cent.

Medical Inspection and Special Methods of Diagnosis.

In Scotland medical inspection of school-children is as yet sporadic or experimental. But the Education Bill now before Parliament contains a medical inspection clause. It is proposed to leave the institution of inspection to the Education Authority, but this authority

[1] Royal Sanitary Institute, Twenty-second Congress Proceedings, 1904.
[2] "Report on Housing and Industrial Conditions in Dundee." Dundee Social Union. Leng and Co. 1905.
[3] In the First Annual Report.
[4] "Report by Medical Officer of Health, Leith, 1907."

must act when required by the Scotch Education Department, and in the manner and to the extent required. An imperial grant-in-aid will be given. If this Bill becomes law, systematic medical inspection will become general over Scotland in a few years. Meanwhile the Edinburgh School Board (40,000 children) has appointed a whole-time medical officer of schools. Govan School Board (30,000 children) has appointed ten part-time medical officers. Kirkcaldy Town Council and School Board have combined to make the Medical Officer of Health also Medical Inspector of Schools. Dunfermline school-children (about 4,000) are systematically inspected by the medical officer of the Dunfermline Carnegie Trust. Inverness School Board has a medical officer. Several special investigations have been made. Edinburgh—first, 600 children for the Royal Commission on Physical Training; second, 1,400 children of a selected school. Glasgow—first, 1,000 children by the Medical Officer of Health; second, 50,000 children for eyes. Aberdeen, 600 children for Royal Commission. Dundee, 1,000 children by Social Union. Leith, 800 children by Medical Officer of Health. And there have been one or two minor investigations. Incidentally, as we have seen, tuberculosis has benefited by the systematic inspection.

But the facts given above show that the methods applicable in school are not adequate. The figures are so capricious that we cannot regard them as representing the truth. Medical inspection is only the first step. It must be followed, in cases of suspected tuberculosis, by the detailed and prolonged observation that is possible only in an organized clinic. The attempts at diagnosis must cease to be casual; they must be repeated and systematic. Diagnosis must go much beyond the "out-patient" standard.

Further, each suspected case must be followed into the home. The report published by the Edinburgh Charity Organization Society has gone far to settle this point. You cannot extirpate tuberculosis in the schools until you deal with the *home conditions* that foster infection, and destroy personal resistance. That is the reason for placing the primary home conditions—number of rooms, number of inmates, occupations—in the forefront of the Medical Inspection Schedule, which then becomes a guide to the economic and sanitary grade of the home as well as to the immediate health-condition of the child. The recently issued English Schedule makes this course possible, but implicitly rather than explicitly. But if medical inspection is seriously to affect the prevalence of tuberculosis, the examination of the child must lead back to the examination of his whole environment—food, sleep, cleansing, family history, occupations of parents, health of other members—and, in general, every circumstance that lessens the likeness of the home to a well-conducted sanatorium. If every case of malnutrition is followed

back to its home environment, the chances of infection will be diminished, and the medical inspector will know how to estimate the danger.

It is easy to foresee that special clinical provision must be made for the "observational" diagnosis of tuberculous cases. And diagnosis must be taken in the wide sense. It implies not merely the recognition of gross disease, which is the climax, but of all the malnutritional conditions that lessen the child's capacity for school-work, or diminish its resistance to common ailments.

As to special methods of diagnosis, there is little to say. Wholesale use of tuberculin is out of the question. Equally so is Calmette's reaction, except under the most stringent hospital conditions. The risk of damage to the eye may not be great; but the risk is positive, not negative. The test would not normally be applied in an out-patient department, and in our opinion it ought not to be applied in schools. This assumes that the test is reliable—a point still unsettled. The eye is too tender and too precious an organ to be exposed to any avoidable risk. We think, too, that with more detailed clinical care, more extended scrutiny of glandular conditions, bones, joints, skin, teeth, tonsils, appetite, circulation, disease history and family history, many marginal cases will come to light. It may be that minute doses of Koch's new tuberculin may become quite safe for diagnosis, but the use of it must be a matter for consultation with the parents. And none of these special methods can be applied profitably except in a regular clinic under skilled supervision.

Special Schools for Tuberculous Cripples and Consumptives.

Cripples.—Except in Glasgow and Edinburgh, almost nothing has been done by school authorities in Scotland to tend the tuberculous cripple. But for some ten years in Glasgow several hundreds of cripples (not all tuberculous) have been provided for in special schools or classes.

A nurse collects the children in an ambulance and brings them to school. There they do appropriate work for a period of the forenoon and afternoon, a period somewhat shorter than the regular school day. The Scotch code allows twenty children to count as sixty for grant purposes. The teachers are specially selected. The children are fed at the expense of their parents except where the poverty is very great, and then charity or the Poor Law intervenes. Cod-liver oil is dispensed systematically.

Last year Edinburgh opened a special school to accommodate some sixty to eighty mentally and physically deficient children. The cripples are treated as in Glasgow. No cases are admitted except on the certificate of the Medical Officer of Schools.

Aberdeen and Dundee are discussing the advisability of establishing special schools.

Consumptives.—As yet there are no special schools for consumptives. But this is only a matter of time. Already the problem is discussed, and probably before long the Waldschule of Charlottenburg will produce its crop of imitators even in our inconstant climate. The Pentland Hills are too full of suggestion to remain much longer unexploited. But apart from the excellent work of the Holiday Home movements, there is little or nothing yet done to provide systematic treatment for phthisical children. That their numbers are not insignificant is proved by the facts we have given from Dr. Philip's dispensary—facts that will be paralleled elsewhere whenever the chance is given.

In the poorhouses there are many tuberculous children. The actual numbers are not available, but they amount to some hundreds. In the large poorhouses, they are usually placed in charge of a trained nurse. At Stobhill, the largest of the Poor Law Hospitals of Glasgow, there are some 400 children, of whom a large proportion are tuberculous. They are treated as they would be in an ordinary hospital. In Duke Street Poor Law Hospital, Glasgow, a large number are also treated. The Govan Parish Combination Poorhouse, which draws patients from a large part of Glasgow, has many tuberculous children in the children's block. There is also a Maritime Home in the Island of Bute. Here some twenty-five cases of chronic bone tuberculosis are maintained. The results are said to be gratifying.

In every poorhouse, from time to time, tuberculous children are to be found; but, with one or two exceptions, none of the poorhouses is well adapted for the treatment of the disease.

Probably the Poor Law medical service will be developed on new lines when the present Poor Law Commission reports. Meanwhile the Poor Law must treat tuberculosis as an incident of destitution, and necessarily is saddled with masses of the most hopeless cases. So long as destitution remains a preliminary condition of relief, so long will the tuberculosis of the poor come in "after the fact." When disease takes equal place with destitution as a title to relief, the Poor Law will begin to be preventive. There is a hope that Poor Law Authority and Sanitary Authority may be so correlated in action that prevention will be a normal part of "treatment."

The General Hygiene of Schools.

All schools are under the general supervision of the Public Health Authorities. Hitherto the supervision has been confined chiefly to infectious disease; but recently, in many localities, both town and county, the sanitation of the schools has been minutely overhauled.

The Medical Officers of Health are under obligation to report annually on schools. Many of them present from time to time a tabulated sanitary survey of the schools in their districts. These surveys are scrutinized by the Local Government Board for Scotland, who, as the Central Authority for Public Health Administration, require the Local Authorities to do what is necessary to remove insanitary conditions. But many conditions that affect efficiency at school may fall short of actual nuisance under the Public Health Act, and these are brought to the notice of the Scotch Education Department, who deal directly with the School Boards. The Inspectors of Schools and the Medical Officers of Health everywhere are getting into touch. The result is a rapid improvement in the general sanitation of schools. School infection of every kind, including phthisis, is under the control and supervision of the Local Authorities for Public Health. This was, two years ago, emphasized by the Local Government Board for Scotland in a circular on the Administrative Control of Pulmonary Phthisis, which has had a very great effect in stimulating and directing the whole anti-tuberculosis movement in Scotland.

This year the Scotch Education Department and the Local Government Board for Scotland, acting together, have issued a detailed memorandum on the Cleansing and Disinfecting of Schools. The directions are minute and exacting; they will ultimately be carried out by every School Board, and the inspectors of the Education Department will report on the work done. Tuberculosis will be affected by these cleansing and disinfecting regulations, which will add one more to the many causes active in the decreasing of the tuberculosis death-rate. (The Regulations can be had of the Government Stationers for 1d.). The spraying of class-rooms, etc., is among the methods most strongly recommended.

The covering memorandum says: "The following directions for the cleaning and keeping clean of schools have been prepared at the request of this Department by the expert advisers of the Local Government Board for Scotland, and are issued under the joint authority of that Board and the Scotch Education Department.

"The directions are based upon actual experience, and take full account of practical difficulties. They represent the minimum precautions that ought to be enforced by every School Board who take due account of the health of the children attending their schools. The Department are, therefore, confident that these directions will receive the careful consideration of all School Boards and managers, and that, after a due interval, His Majesty's Inspectors will be able to report that, in every school in the country, the instructions now issued are being observed, except where it has happily been found possible to better them."

The Care and Control of Tuberculous Teachers.

No general measures are taken with tuberculous teachers as such; but, like all others, they are directly or indirectly affected by the view taken of phthisis. In Scotland the official view, as fully expounded in the circular issued by the Local Government Board for Scotland in March, 1906, is that phthisis is an infectious disease within the meaning of the Public Health (Scotland) Act, 1897, and is subject to the provisions of that Act just like enteric fever or erysipelas. A few of those provisions, however, were too stringent in their application, and last year (1907) a three-clause Act was passed to modify the three unconditional sections of the 1897 Act. It can now be said with perfect truth that every clause of the Public Health Act as amended can be adapted in practice to the nature and conditions of phthisis without any risk of causing unnecessary individual hardship. Thus, the ordinary Public Health Law has been made elastic enough to cover every phase of phthisis, and to enable any Medical Officer of Health to do what circumstances indicate. This, it was felt, was a sounder policy than to permit special localities to move off under special Parliamentary powers, and so get out of line and touch with the rest of the country. Every Local Authority has full powers, and can exercise them as conditions require and allow. The Board will, no doubt, shortly issue a statement showing what progress has followed the circular of 1906. Very few localities have failed to do something. The general movement will affect teachers among others.

But the teaching profession has another safeguard. Two years ago the training of teachers became a national service. The Training Colleges, with two exceptions (Episcopalian and Catholic), were transferred to provincial committees, who administer Imperial funds. Every teacher, when he enters as a student in training under a provincial committee, must be examined by a Medical Officer, who acts by the "insurance" standard. Anything that would imperil the superannuation fund may involve rejection; hence, phthisis tends to be excluded. Further, the Medical Officer has medical charge of the students during their two or three years' training. The students are required to take a course of physical training under medical direction. Thus, at all stages of their course they are protected.

Before a student can become a full student in training he must be trained for three years as a junior student under a School Board. Before he enters on this junior course, he is medically examined and certified. The chance a consumptive teacher has of passing these two medical examinations—one at entrance as a junior student, and one at entrance as a student in training—is very small. Thus, in time, pulmonary tuberculosis will tend to disappear from the teaching profession.

Meanwhile, School Boards give "sick leave" for tuberculosis as for other "break-down" diseases. But when the Administrative Control of Pulmonary Tuberculosis has extended to an adequate sanatorium service—a matter of time—teachers will benefit among the first, since the nature of their occupation compels an early revelation of their disablement. When "open-air" schools are a reality, the "open-air" teacher will probably be chosen from among the phthisical or phthisically inclined.

Notification of Tuberculous Children.

In Scotland, as the 1906 circular intimated, the Local Government Board are prepared, on conditions, to sanction the addition of pulmonary phthisis to the list of compulsorily notifiable diseases. The "conditions" are essentially that the Local Authority is prepared to do something definitely practical to prevent the disease. Edinburgh City, a year ago, made phthisis compulsorily notifiable. Recently, Lanark County—all three wards—did the same. Lanark is the largest Scotch county. Several small towns and one or two county districts have added the disease to the list for periods varying from a year to five years.

Apart from notification, these and many other places have arranged with sanatoria for the use of beds, or have adapted their infectious disease hospitals, or have combined to build a sanatorium (one case), or have themselves built small sanatoria (two cases).

In this movement we cannot separate what affects the schools from what affects the general public. Hence the details now given.

Prophylactic Measures.

The Edinburgh Charity Organization Society's Report, so often mentioned, showed how much there is to do if the homes of our children are to be made efficient. In Scotland the feeding of school-children has not yet been settled. The Bill now before Parliament links under-feeding with want of proper clothing, uncleanliness, and, generally, neglect. Under-feeding becomes an offence under the Cruelty to Children Acts (to be modified by the Children's Bill now being discussed). The parents are thus directly "got at." Where the children cannot, for adequate reasons, be attended to—fed, cleansed, clothed, etc.—the parents can be punished; but, at the same time, the School Board, if satisfied that no voluntary agency can undertake the feeding, may feed the child at the expense of the education rate for as long as may be necessary. This involves no disability of the parents. These provisions, by giving the School Board powers to investigate and prosecute for neglect, will affect the family directly. Under-feeding, with its normal accompaniments, is largely a "function" of

the irresponsibility due to alcohol. When, therefore, the under-fed child becomes an occasion for action, alcoholism, too, will come under the lash. Thus, directly and indirectly, the tuberculous child will benefit —directly, because he will be more likely to get fed; indirectly, because the tightening of the family responsibility will diminish general neglect.

In the Edinburgh Report for the Royal Commission on Physical Training, some reasons were given for concluding that many children in a given school were under-fed. By this was meant under-nourished; not acutely, but chronically, starved. And want of food was only one among many of the causes of starvation. There were, too, want of air, want of sleep, want of cleanliness, want of regularity in feeding. We have seen other figures since then, but we have found nothing to modify those views. Whatever be the explanation, whatever be the remedy, a certain large percentage of children are not nourished up to their normal physiological level. As the Charity Organization Society's Report showed, it was not often want of money. Among immediately positive causes, alcoholism played a considerable part.

That under-nutrition increases the tendency to tuberculosis needs no proof. It is already established by many lines of argument. But, so far as they go, the Edinburgh figures, both early and recent, confirmed the conclusion.

We are not concerned with the methods of arranging for the feeding of school-children. Everyone is agreed on the end; the means are a matter of political detail. The present Scottish Bill has yet to run the gauntlet of Parliamentary criticism, and there is the short experience of England as a guide.

The Special Instruction of School-teachers and Children in Anti-Tuberculous Procedures.

The first stage in teaching the child is to teach the teacher. In Scotland this is now fully provided for. In all the four training centres—Aberdeen, Edinburgh, Glasgow, St. Andrews—there is a whole-time Medical Lecturer, whose duty it is to teach personal and school hygiene to students in training. He also has a general supervision over the preparatory hygiene work (physiology, etc.) of the junior students at the various schools in the provinces. The course at the training centre consists of seventy hours' instruction, which includes principles of physical training as well as of personal hygiene. The general lines of the courses are sketched in a General Report prepared for the Education Department in 1907.[1] Briefly, the effort

[1] Mackenzie, W. L.: "On the Teaching of School and Personal Hygiene to Students in Training as Teachers in Scotland." London: Wyman and Sons. 1907. Price 1d.

has been to discourage generalized "lecturing," and to encourage direct observational study. Every student is brought face to face with children, made to examine them, inspect, touch, question, etc., and then to record what he or she finds in words as exact as possible. Eyes, ears, throat, teeth, glands, bones, joints, skin, hair, general nutrition, colour, gait, posture, deformities, curvatures, rickets, etc., thus become actual "Nature-knowledge" studies in the concrete, children being substituted for flowers or rocks or animals. The "records" are made a basis for the "final mark" by the lecturer. They are scrutinized, like any other examination papers, by the Inspector. Direct contact with the actual is now, practically in all the Centres, the main part of the course. The results have been of the most gratifying order.

Incidentally, tuberculosis, and all that leads to it, bulk largely in the courses. The general hygiene of the school is correlated with the personal hygiene of the child. The physical education of the students themselves under the Medical Lecturer's supervision[1] is the flower of the system. When these students become teachers they will find their minds filled with concrete cases of many kinds; they will be constantly observing and recording, and so they will as naturally look for the ailing child and direct him to the doctor as they will maintain for themselves a hygienic environment in the school. They will know what to teach their children; they will know how to act themselves. Meanwhile, there have been formed many classes of acting teachers, who are anxious to learn what to do.

These educational measures are constructively preventive of all preventable disease—of tuberculosis not least.

[1] Mackenzie, W. Leslie, and Foster, Captain Alan: "Memorandum on Systems of Physical Training, and their Relation to the Hygiene of School Life." Issued by the Scotch Education Department. 1907.

XXXIX.

THE PREVENTION AND ARREST OF TUBERCULOSIS IN INFANCY AND CHILDHOOD.

By the EDITOR.

Tuberculosis must be considered and dealt with as a preventable disease. In many of its forms it is eminently curable. Under seemingly the most unfavourable conditions Nature often secures an arrest of the morbid process. Even when no permanent restoration is possible, much amelioration may be attained by suitable treatment. Hitherto comparatively little has been accomplished towards attaining a scientifically directed systematization of efforts to provide adequate protection of infants and children from tuberculous invasion; and for those who have fallen victims necessary provision for the employment of restorative agencies is at present altogether inadequate. The importance of the subject and the need for immediate action have been abundantly demonstrated in the preceding pages. It only remains for this concluding chapter to indicate briefly some of the more pressing practical conclusions.

The Early Diagnosis and Treatment of Tuberculosis in Children.

Tuberculosis in its beginnings is not easily discovered. Only too frequently the disease has made considerable headway before it is recognized. The difficulties of diagnosis are considerable. The late Dr. Ashby and Professor G. A. Wright, in their classical work, say: "It cannot be said with any accuracy what proportion of our child population suffers from tuberculosis, and statistics cannot be of much value on account of the impossibility of diagnosing tuberculosis of the internal organs, especially in the milder forms."[1]

Dr. Newsholme, in his recent informing monograph, deals with this matter of inaccurate diagnosis in children.[2] "In children,

[1] Ashby, H., and Wright, G. A.: "The Diseases of Children." Fifth edition. London, 1905.

[2] Newsholme, A.: "The Prevention of Tuberculosis." London, 1908.

the term 'broncho-pneumonia' not infrequently conceals acute tuberculosis, especially when the broncho-pneumonia occurs after imperfect recovery from such diseases as whooping-cough and measles. Coates (1891) has drawn attention to the frequency of errors of diagnosis in children. He quotes the figures of the Great Ormond Street Children's Hospital, London, for 1877, which showed that of seventy-seven deaths from all causes, 35·5 per cent. were due to tuberculosis; and he considers that we may safely affirm that of the total deaths under ten years of age among the masses of the people, one-third are due to tuberculosis. In Paris, according to Landouzy, one-third of the deaths under two are due to tuberculosis."

Dr. John M'Caw,[1] of Belfast, has made an interesting comparative study as to the proportion of tuberculous cases met with in various British hospitals for children. His results have been previously quoted (p. 202).

Tuberculous lesions often develop and become arrested without ever having been recognized clinically. Ganghofner[2] of Prague, in 1,800 post-mortem examinations on children dying in that city from causes other than tuberculosis, and presenting no symptoms of tuberculosis, obtained results as follows:

Among 460 deaths of children in the first year of life, latent tuberculosis was found in 33 = 7·1 per cent.

Among 536 deaths of children aged one to two years, latent tuberculosis was found in 86 = 16 per cent.

Among 476 deaths of children aged two to four years, latent tuberculosis was found in 117 = 24·5 per cent.

Among 271 deaths of children aged four to six years, latent tuberculosis was found in 73 = 26·9 per cent.

Among 123 deaths of children aged six to eight years, latent tuberculosis was found in 33 = 26·8 per cent.

From a practical standpoint it is very desirable that accurate returns should be forthcoming with regard to all children in public schools, orphanages, and other establishments for the young who are the subjects of active tuberculous disease or in whom "revealed" tuberculous lesions exist.

Dr. John H. Lowman[3] has devoted much study to the question of

[1] M'Caw, J.: "Tuberculosis in Childhood and its Relation to Milk." Presidential Address to the Ulster Medical Society, *British Medical Journal*, December 21, 1907.

[2] Ganghofner, F.: "Préservation Scolaire contre la Tuberculose," *Rapports présentés au Congrès Internat. de la Tuberculose.* Paris, 1905. See also reference in Official Report on Paris International Tuberculosis Congress of 1905, by C. Theodore Williams, M.A., M.D., F.R.C.P., and H. Timbrell Bulstrode, M.A., M.D., D.P.H. London: 1906.

[3] Lowman, J. H.: "Tuberculosis and the Schools," *Charities and the Commons*, vol. xviii., p. 657. New York, 1907.

tuberculosis among the school-children of the United States. "In one school district of 1,420 families, 572 families were visited and 67 cases of adult tuberculosis found. In the fifty-seven houses in which these cases were found, 151 children were exposed to infection. If the same rate of adult cases prevailed throughout the district, and the number of children also averaged in the same way, we should have in the school district, assuming that the figures found in the dispensary are correct, 27 cases of positive pulmonary tuberculosis and 54 that are strongly suspected of having tuberculosis. Not all these would be of school age, but there would be 81 children in one school district of 1,200 pupils who would require surveillance. If only one-third of these were actually in attendance at school, there would be abundant opportunity for the infection of the others who are sound."

As regards the prevalence of pulmonary tuberculosis in British school-children, we have a certain amount of evidence. Dr. Newsholme summarizes this as follows: "The proportion of children in elementary schools with revealed phthisis appears to be 1 in 43 (Edinburgh), 1 in 69 (Edinburgh, second series), 1 in 200 (Aberdeen), and 1 in 296 (Brighton). Compare these figures with the estimate of 1 in 333 children based on the national death-rate, and on the assumption that ten non-fatal cases go to every fatal case, I incline to think that there is not, on the average, more than 1 in 300 children in schools showing revealed or diagnosable phthisis." Be this estimate correct or not, it is manifest that a much larger proportion, if not already seriously affected with tubercle, are markedly predisposed thereto, and stand in need of prompt anti-tuberculosis management.

The means and methods for the early recognition of tuberculosis in early life have been dealt with in preceding sections. The evidence is often presumptive rather than actual. In addition to the usual procedures for the clinical examination of children, modern research has rendered additional resources available.

Radioscopy and radiography seem sometimes to afford aid in the detection of intra-thoracic lesions in children. Turban[1] gives it as his opinion that "the scanty and uncertain signs of tuberculosis of the bronchial glands obtained by percussion and auscultation, supplemented by the X-ray appearances, may render diagnosis possible—at any rate, in children and in cases where the enlargement extends in some degree to the right of the spine."

Walsham and Orton[2] also show that by means of the Roentgen

[1] Turban, K.: "The Diagnosis of Tuberculosis of the Lung, with Special Reference to the Early Stages." English translation by Dr. Egbert C. Morland. London: 1905.

[2] Walsham, H., and Orton, G. Harrison: "The Roentgen Rays in the Diagnosis of Diseases of the Chest." London, 1906.

rays assistance may sometimes be afforded in the detection of enlarged tuberculous glands.

Hochsinger[1] points out, however, that special care is needed in the interpretation of radioscopic work in young subjects, for "the shadow of the heart in infancy and early childhood offers especial peculiarities on account of the proximity of the heart to the thymus gland and to the high position of the diaphragm."

The ophthalmic and cutaneous reactions[2] associated with the names of Calmette, Wolff-Eisner, and von Pirquet promise, when used with discrimination, to be of much diagnostic service in the early recognition of tuberculosis in early life. These methods of investigation have received full recognition in previous sections of this work.

It is very desirable that Holt's method of collecting sputum from young subjects with early tuberculous involvement of the lungs should be systematically employed in children's hospitals. His results are certainly surprising.[3]

It is to be hoped that in the medical inspection of children now being systematically undertaken in this and other lands arrangements will be made for the thorough examination of all tuberculous and tuberculously disposed children and teachers by expert examiners.

In the present enthusiasm for safeguarding the children, the needs of the teacher must not be overlooked. Teachers suffer heavily from tuberculosis. Every physician of experience must know of many cases where teachers have been compelled to struggle on with school duties even when seriously ill with tuberculosis. Every education authority should make arrangements for the periodical examination of their teaching staff. The action of Denmark in this matter might well be followed: "Against the infection of children by their teachers preventive measures have been provided, and every teacher on appointment to a public school is obliged to present a medical certificate, not more than three months old, stating that he is not affected by any contagious form of tuberculosis of the lungs or the larynx. If a teacher is found to be suffering from either of such forms of tuberculosis, he may be dismissed with a pension of not less than two-

[1] Hochsinger, C.: "Diseases of the Circulatory System," in Pfaundler and Schlossmann's "Diseases of Children," vol. iii., p. 451. Philadelphia and London, 1908.

[2] Wolff-Eisner, A.: "The Ophthalmic and Cutaneous Diagnosis of Tuberculosis." English translation by Bernard I. Robert. London, 1908. The busy practitioner will find valuable information in a readily accessible form on these reactions and on the use of other preparations of tuberculin in the recently issued thirteenth edition of Martindale and Westcott's "Extra Pharmacopœia," pp. 859–880. London, 1908.

[3] Holt, L. Emmett: "Some Points in the Diagnosis of Tuberculosis in Infancy and Childhood," *British Journal of Tuberculosis*, October, 1907; see also p. 99 of this work.

thirds of his previous salary. This rule also applies to all other State employés who are in direct contact with many people."[1]

Flatau,[2] in discussing this matter, concludes thus: "When school physicians are appointed to all schools, including the higher schools, they must be empowered to act not only in reference to the scholars, but also in reference to the teachers who are ill."

In preceding portions of this work stress has been laid on the importance of safeguarding children of school age from invasion by tuberculosis, and where they are already affected or present tendencies to the disease the necessity for special treatment has been insisted on. Through the mechanism of our educational system, there is now provided means whereby effective anti-tuberculosis procedures may be undertaken. It is essential that educational authorities should realize the need and recognize their opportunity. If tuberculosis is to be eliminated from the schools, it must be by the loyal and enthusiastic co-operation of all concerned in the care of the children. Thorough medical inspection by skilled examiners must discover "active" cases, and as far as possible classify "latent" and "predisposed" cases. Children with active tuberculous disease, especially those where the mischief involves the lungs, are to be considered as possible sources of infection, and must be sent to suitable sanatoria. Children with inherited or acquired tendencies to tuberculosis should be cared for in special open-air schools. For the proper care and control of tuberculous and tuberculously disposed children during holiday times, special arrangements should be made with voluntary societies or other agencies, whereby residence may be secured in the country or at the seaside under proper hygienic conditions and adequate medical and nursing supervision.

There is also need for greater care in the selection of homes, foster parents and nurses for children. It is folly to "board out" a tuberculously predisposed child with a country family or send it to any institution unless careful investigation has shown that the home or establishment is not only structurally suitable, but also managed by wise and healthy persons. In Denmark, in order to protect children from tuberculosis, laws have been passed giving to sanitary boards the right to forbid consumptive women to act as nurses. "Before the sanitary board grants a licence to a female, allowing her to undertake the care of a child (for a salary), a certificate from a medical man must be procured, testifying that no cases of contagious tuberculosis are to be found in the home; and also that the

[1] Bie, V., and Maar, V.: "The Campaign against Tuberculosis in Denmark," *British Journal of Tuberculosis*, April, 1907.

[2] Flatau, T. S.: "The Prevention of the Diseases of the Throat and Nose," in "The Prevention of Disease," p. 830. English translation edited by H. Timbrell Bulstrode, M.A., M.D. London, 1902.

child itself is not affected by tuberculosis, supposing the child is to be received into a home where there are other children."

Endeavour is being made in this and other countries to provide thorough instruction of the teachers in the principles of hygiene. There is urgent need that all responsible for the instruction of children should themselves fully understand and realize the importance of applying anti-tuberculosis principles and methods. The benefits of the best-designed school may be in great measure neutralized by the ignorance or selfishness of a teacher. All scholars, both by precept and example, should be taught those habits of thought and action which afford the surest safeguards against the invasion of tuberculosis and other ills.

In the United States of America a praiseworthy effort is being made to render the children's playground a more effective instrument in the maintenance of health and habits which shall successfully resist the development of tuberculosis.[1]

Metropolitan Open-air Schools.

Slowly but surely London is following the example set by Germany. The provision of open-air schools for tuberculous, tuberculously disposed and other delicate children marks a great stride in our educational evolution. Before long it may be expected that throughout the country open-air schools will be available for all subnormal children requiring them.

Last year London carried out the first systematic English experiment with conspicuous success. An open-air school was conducted in Bostall Wood from July 22 to October 19—a period of thirteen weeks. All the children were submitted to thorough medical examination. Of the 102 children, 63 had "glands in neck palpably enlarged," and 13 "showed marked signs of tuberculous diathesis." A valuable report of the experiment has been issued by Dr. James Kerr, the medical officer of the Education Committee of the London County Council, Mr. R. Blair, the executive officer, and others concerned in the conduct of the open-air school.[2] This epoch-marking report should be studied by all interested in the management of schools or in any way responsible for the care of school-children. It contains a series of instructive illustrations, showing the children engaged in physical exercises, taking part in a reading lesson, undergoing afternoon rest, digging, sketching, and dining—all in the open.

[1] Favill, H. B.: "Playgrounds in the Prevention of Tuberculosis," *Charities and the Commons*, vol. xviii., p. 501. New York, 1907.

[2] "Report of the Education Committee of the London County Council on the Open-air School at Bostall Wood (Plumstead)." London: P. S. King and Son, 2 and 4, Great Smith Street, Victoria Street, Westminster, S.W. 1908. Price 1s.

A particularly valuable feature of the publication is a special report by Dr. Frederick Rose, the Assistant Educational Adviser, on "Ex-

FIG. 20.—LESSONS AT THE LONDON COUNTY COUNCIL'S OPEN-AIR SCHOOL AT SHOOTER'S HILL.

periments conducted in Germany in connection with Open-air Schools," and giving illustrations of the Charlottenburg and the M. Gladbach schools.

This year the London County Council has very wisely extended the work. Three open-air schools, each with accommodation for

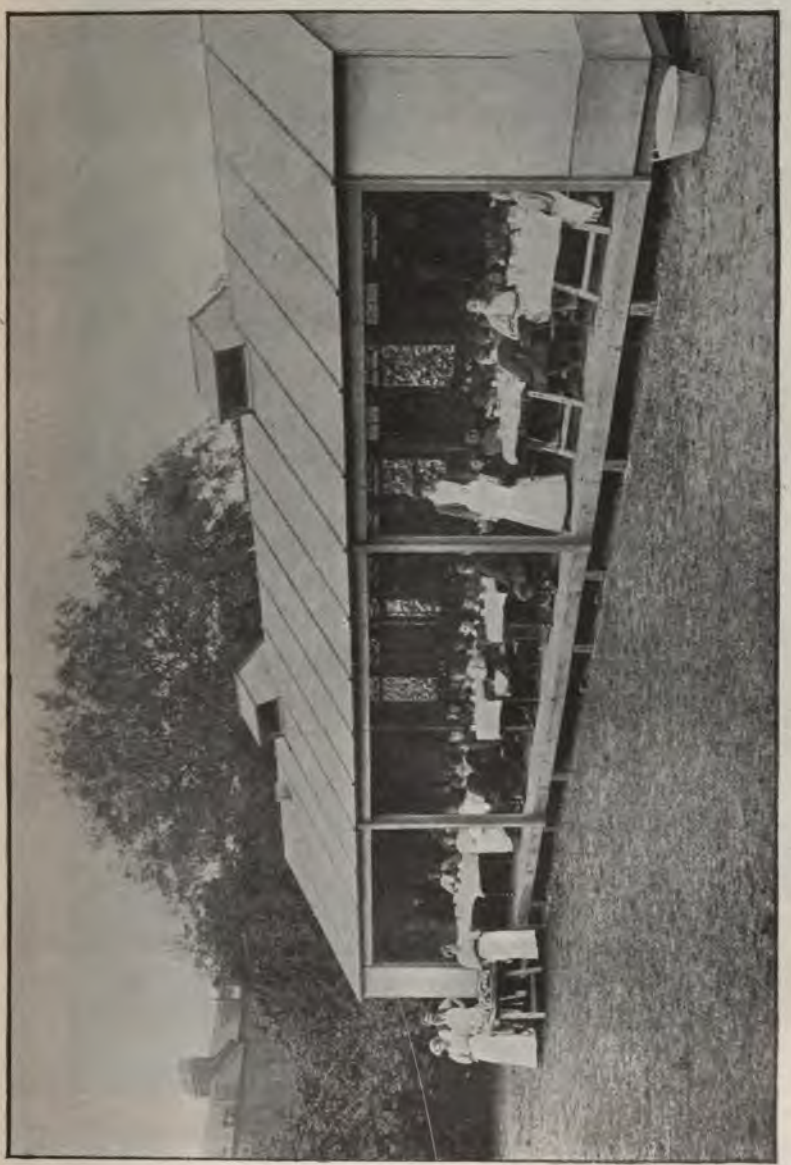

FIG. 21.—MEAL-TIME AT THE LONDON COUNTY COUNCIL'S OPEN-AIR SCHOOL AT KENTISH TOWN.

seventy-five children, have been established in Kentish Town, the Horniman Park, and on Shooter's Hill. Through the courtesy of Messrs. Hasserodt and Co., who have provided the buildings for these

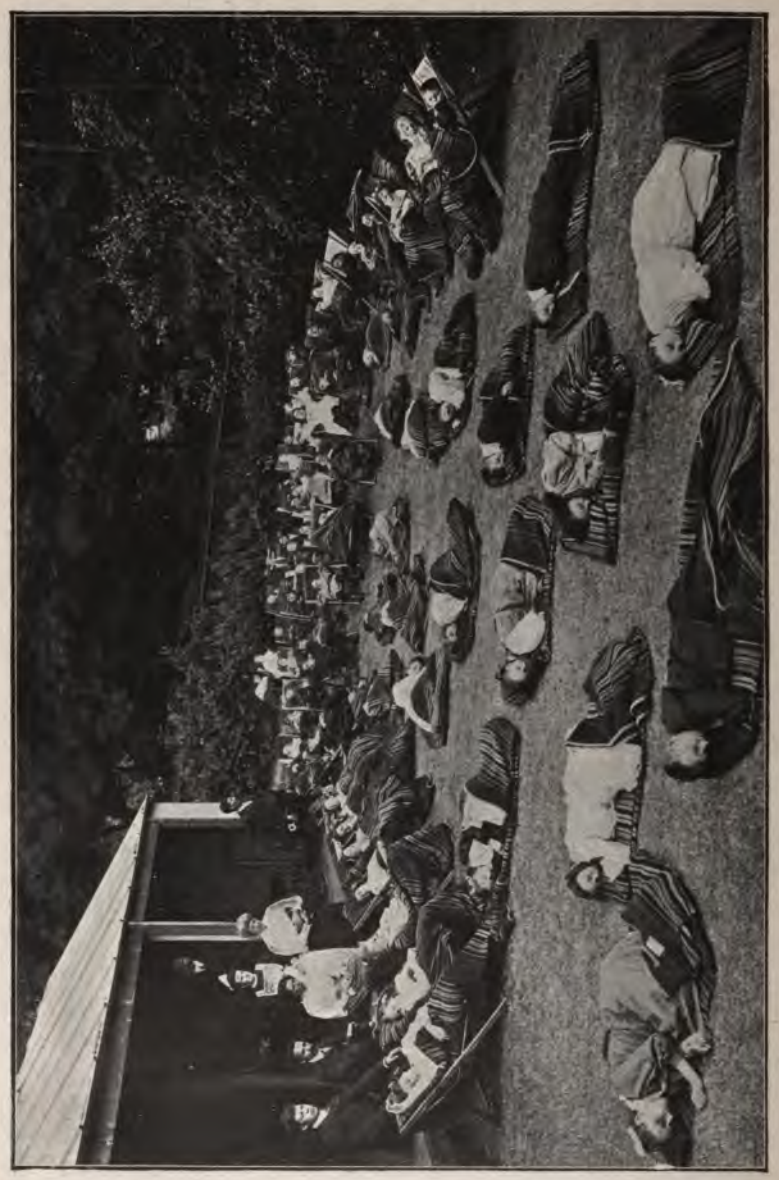

FIG. 22.—RESTING AT THE LONDON COUNTY COUNCIL'S OPEN-AIR SCHOOL AT HORNIMAN PARK, LORDSHIP LANE.

open-air schools, I am enabled to give illustrations which will probably be more instructive than long and detailed descriptions.[1]

[1] Full particulars of the "Doecker" buildings now being used in the open-air schools of Germany and London may be obtained on application to Messrs. Hasserodt and Co., 31, Queen Street, London, E.C.

The Establishment of Open-Air Schools.

In order to deal justly and effectively with the vast number of delicate children predisposed to tuberculosis and other crippling and debilitating ailments, open-air schools are essential. It is estimated that in London alone there are from 35,000 to 40,000 children requiring such special provision. From such a calculation it may be possible to form some numerical expression of the needs of children in crowded provincial cities and towns of this and other lands. It must also be remembered that in many country districts the school accommodation is deficient in nearly all hygienic requisites, and accentuates rather than corrects the prejudicial influences present in many cottage homes.

Viewed purely from the educational standpoint, open-air schools are now seen to be absolutely necessary for many children. The watchful skill and spirit of the hospital must be brought into the school, and something of the discipline and educational advantages of the school must be brought into the hospital. For tuberculous and other delicate little inmates of both school and hospital a hygienic environment must be maintained, and this can be best attained by the adoption of what is conveniently termed "open-air" methods. Experience and experiment have established the truth of this statement. The only difficulties now seem to lie in discovering ways and means and meeting cost.

It is unnecessary to enter here into a discussion concerning merely architectural and structural features. For an open-air school simplicity and effectiveness are essential, and both may be maintained at comparatively small expense. The economic aspect of the problem is all-important. In the Bostall Wood experiment of the London County Council the whole cost for school maintenance for three months of each child was £7 10s. 2d. "From this must be deducted (1) the parents' contributions, which averaged 11s. 3d. for each child, and (2) grant payable at the rate of £4 10s. per annum for each child in average attendance, amounting to about £1 2s. 6d. per child, making the net cost per child £5 16s. 5d."

If, however, the maximum of benefit is to be attained for many of these children, especially those who are definitely tuberculous, tuberculously disposed, or come from tuberculous homes, residential open-air schools must be provided. To care for a consumptive or tuberculously predisposed child in an open-air school during the day, and then send him home to a slum, where he has to spend the night in an overcrowded, dirty, airless bedroom, and it may be in close association with tuberculous parents or others, is folly exemplified. Sooner or later we shall be compelled to provide for such children permanent

care in residential open-air school colonies. The sooner the situation is faced the better both for the nation and individual.

Dr. Rose has given much attention to the evolution of the open-air school. As an expert in educational methods, his opinions merit careful consideration. I make no apology, therefore, for quoting at some length from a valuable and suggestive brochure which he has recently published.[1]

"The Education Act (Administrative Provisions) passed by Parliament last year makes school medical inspection compulsory on local educational authorities, and empowers them to incur expenditure on behalf of the health of children at elementary schools. This makes the establishment of open-air schools an easy task, and a few remarks may be added showing how this should be carried out.

"As far as debilitated children are concerned, the following guiding principles should be observed : (1) Debilitated children, and those suffering from mild chronic ailments and incipient forms of disease, should be separated out and placed in open-air schools. These should be situated in a wood, if possible upon a gravel or sandy subsoil, and should be protected by high ground on the north and east. Pine or fir woods are the best. (2) The hygienic aim of such a school should be to strengthen and cure the children by simple hygienic measures, such as fresh air and sunshine, plentiful and suitable food, baths, exercise, and periods of absolute rest. (3) From the educational point of view it should be remembered that the children attend for physical recuperation and cure, combined with the minimum of school work necessary to prevent them falling behind in their work. The classes should not exceed twenty-five children to a teacher, the formal book and desk instruction should be reduced by about one-half, and the rest of the instruction should be given in an informal manner and adapted to outdoor conditions.

"The children should be selected by the school doctor, who would consider poor and congested town areas in the first place. A careful individual record of the children's physical condition should be kept by means of the card system. Before entering the school their teeth should be examined and put in order, otherwise they will not derive the proper benefit from their food. It must be remembered that no less than 90 per cent. of our children suffer from defective teeth, which are also responsible for many other ailments, much unnecessary suffering, and lowered vitality.

"It is important to remember that an open-air school is not only a physical, but also an educational institution, and that both aspects of the school are equally important. The children's health will, of course,

[1] "Open-air Schools," by Dr. Frederick Rose, prepared for the Country-in-Town Exhibition, Whitechapel Art Gallery, July 2 to 16, 1908.

improve, owing to the regular feeding and improved surroundings, but unless care is exercised the educational aim may be neglected. Great

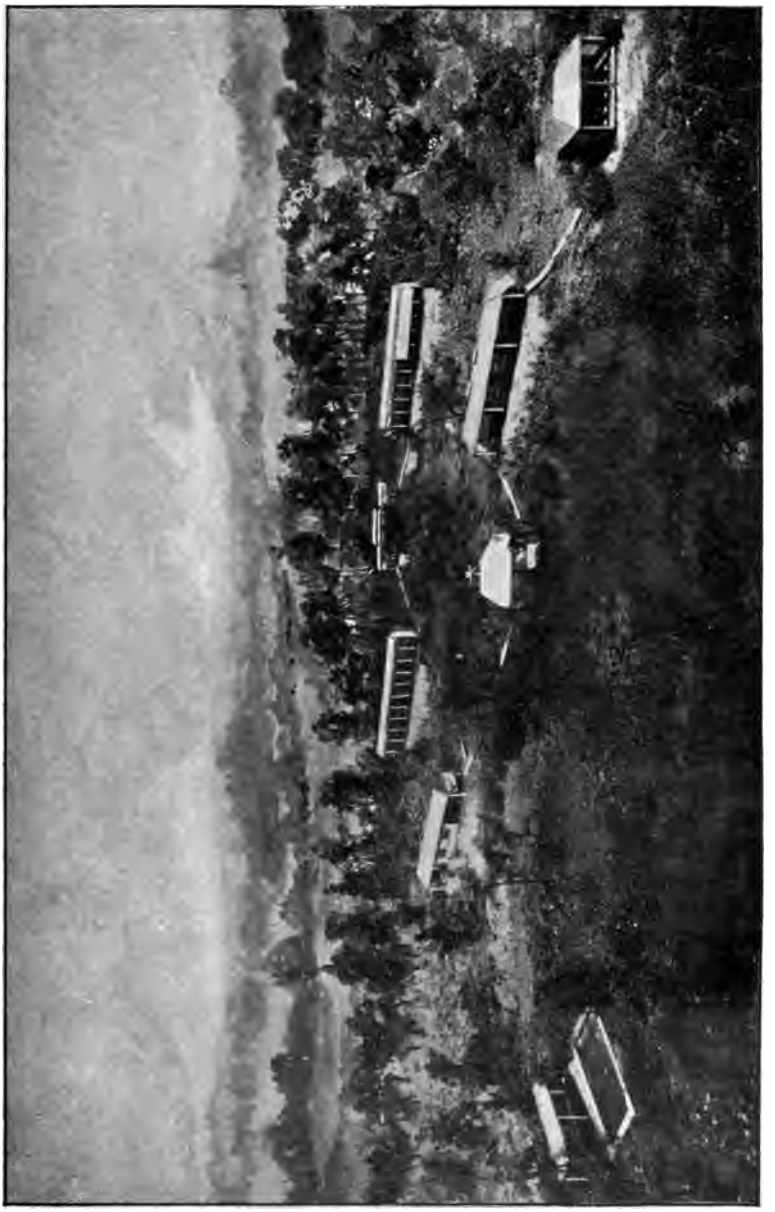

FIG. 23.—MODEL OF AN OPEN-AIR SCHOOL CONSTRUCTED FOR THE COUNTRY-IN-TOWN EXHIBITION OF 1908 BY DR. FREDERICK ROSE, ASSISTANT EDUCATIONAL ADVISER OF THE LONDON COUNTY COUNCIL.

attention should be paid to the new outdoor methods of teaching, concerning which a few hints may be given.

"In arithmetic the children should be provided with tape measures, and should use them as much as possible. They should base their sums on actual outdoor measurements made by themselves, and not merely manipulate and juggle with abstract figures. The whole of the surroundings and daily life of the school can be drawn upon for suitable examples.

"Geography should be taught as much as possible in the open. Relief-maps should be made to scale in sand, and the configuration of the surrounding country explained. An immense amount of geographical instruction can be imparted with the help of a stream or rivulet.

"In teaching history the children should be taught to act historical episodes as much as possible, using their own words.

"It is scarcely necessary to show to what a great extent Nature-study will benefit by being taught entirely in the open. Children will be trained to observe and study animal life, but not to destroy it. The lives of plants, animals, and insects can be studied at first hand, and during their whole development. The decomposition of rocks and the formation of soils can be explained, and a large amount of weather observations and study of the heavens can be carried on.

"The children should be taught to look upon themselves as a large family, and should be trained to the exercise of the qualities necessary for ordered life in communities. Generally speaking, the leading principle of the school should be frequent change from work to play, reading, singing, and rest, together with constant stimulation of interest."

I am able to here reproduce an illustration of a model of an open-air school designed by Dr. Rose (Fig. 23), together with the estimate of cost.[1]

"By giving the figures mentioned on p. 337, it is assumed that the price of the land is not included, and that gas, water, and drainage connections are easily available. It is further assumed that, with proper care and repairs, the life of the school buildings would be at least fifty years, and that the following materials have been used for construction purposes: rough cast for outside walls, wood for inside division walls, tiles for roofs of buildings, cement and bricks where necessary and easily procurable in the district.

[1] For the loan of the block of Fig. 23, I am indebted to Messrs. Hasserodt and Co., of 31, Queen Street, London, E.C., who will supply full particulars of the scheme. Dr. Frederick Rose, in his article on "Open-air Schools" in *Progress*, April, 1908 (the organ of "The British Institute of Social Service," 11, Southampton Row, London, W.C.), describes the evolution of the movement and gives particulars of the expenditure entailed in establishing the first German open-air school at Charlottenburg.

"The estimate is, roughly, as follows :

"Two school buildings, £350 each	£700
"Two sleeping-sheds, £300 each...	600
"Gas, water, drainage, laying out	200
"Dining-shed, kitchen, etc.	200
"Offices and baths	150
"Swimming-pool and dressing-shed	90
"Assembly shed (gravel floor)	60
	£2,000

"The total of £2,000 works out at £20 per place for a residential open-air school for 100 children. If it were a day open-air school £600 for the sleeping-sheds should be deducted, and the price would be about £1,400, or £14 per place. If the day open-air school were not provided with feeding and bathing facilities a further sum of £350 should be deducted, and the cost would then be about £1,050, or £10 10s. per place. If the school were established as a residential or day open-air school for a larger number of children than a hundred, the prices per place just given could perhaps be reduced still further, as it is cheaper to build for large than for small numbers. It appears, then, that such open-air schools could be built at a reduction of at least one-third of the expenditure generally incurred for the erection of the ordinary heavy brick and mortar school buildings. From the point of view of the health of the children, the open-air school type is to be preferred in every respect. It would, of course, be necessary to modify the existing regulations for school buildings for the purposes of open-air schools, but this is no insuperable obstacle.

"There is, further, no reason why open-air school buildings should not be made of portable materials, and taken to pieces and moved when necessary. This would involve, of course, a suitable choice of materials and a different mode of erection—namely, portable sections fitting on to one another. But it would probably cause extra expenditure for gas, water, and drainage. The great success of the portable 'Doecker' school buildings on the Continent and in some parts of England has shown that this can be done, even for a school of 600 children, as often as necessary, quickly and with great ease. At Berlin, for example, there is a portable 'Doecker' school of no less than twenty-two class-rooms and a gymnasium."

British Hospitals and Sanatoria for Tuberculous Children.

In this country up till quite recently there were no special establishments for tuberculous children. These cases had to be treated in general hospitals for children or such other institutions as could be induced to take them. A large number of the 21,769 children now

under the care of Poor Law authorities in the workhouses and workhouse infirmaries of England and Wales[1] are tuberculous, or are to be considered as having marked tuberculous tendencies.

It is estimated that no less than from 20 to 30 per cent. of all the patients in British children's hospitals are tuberculous. In this country it must be sorrowfully admitted that, in proportion to our population and our resources, we are far behind many other countries in adequate provision for the hygienic treatment of tuberculous children.[2] "It has been calculated that, whereas in France there are between 5,000 and 6,000 beds for the rational treatment of tuberculous disease in children, in England there are not 500."[3]

The ordinary urban hospital is most undesirable for tuberculous children. In 1903 Tubby[4] dealt with this matter. His conclusions may well be quoted here:

"1. Tubercular children should not be put in hospitals in cities or large towns, but properly-equipped establishments should be started in the country or at the seaside. The increasing means of communication will easily meet the difficulty of the attendance of competent surgical officers.

"2. These hospitals should be devoted to one object only, just in the same way as sanatoria exist for the open-air treatment of phthisis alone. If internal tubercle is treated in special hospitals, why not external?

"3. The rural hospitals must be conducted on definite principles. There should be no limit as to age, the younger children being equally eligible with the older. In fact, the younger the child the more hopeful is its case, and the more urgent is it to take it in hand at once and thoroughly. Cases once admitted should stay until they are cured, or clearly proved to be incurable; and for the latter separate establishments should be provided, so that they cease to be a danger to the community. Cases which are undergoing cure should not be liable to interruption, owing to the want of subscribers' letters or other red-tapeism, and a case once entered upon must be followed right through."

Sutcliffe,[5] of Margate, has recently stated: "That the results of operative treatment in Metropolitan hospitals is to leave an unduly

[1] This return is for 1906. See Gorst, Sir John E.: "The Children of the Nation," p. 231. London, 1906.

[2] Kelynack, T. N.: "The Tuberculous Child," *Journal of the Royal Institute of Public Health*, October, 1907.

[3] Thomson, H. Hyslop: Chapter on "Tuberculosis in Childhood" in "Pulmonary Phthisis: its Diagnosis, Prognosis, and Treatment." London, 1906.

[4] Tubby, A. H.: "Is the Urban Hospital Treatment of External or Surgical Tuberculosis Justifiable?" *Practitioner*, September, 1903.

[5] Sutcliffe, W. G.: "Observations on Treatment of Disease of the Hip and Knee Joints in Children," Metropolitan Asylums Board Annual Report for 1907, p. 361. London, 1908. See also Dr. James Kerr's valuable and suggestive reports as Medical Officer to the Education Committee of the London County Council.

large number of badly crippled children on the hands of the public is shown by Dr. Kerr's report to the London Education Committee on tuberculosis in school-children." He concludes: "It is evident that children affected with tuberculosis of joints, and especially of the hip and knee, are likely to do far better, and to escape with fewer deformities, if they are under suitable conditions from beginning to end of their treatment, and that sooner or later the public will realize that their charity would be better employed in providing such conditions than in perpetuating the temporizing methods of the Metropolitan hospitals."

For all tuberculous and tuberculously disposed children residence in urban hospitals, schools, orphanages, and other institutions is unjustifiable. Of this there can be no doubt. But under present conditions we have in only too many instances to make the best of what is available. Even in London efforts to provide open-air treatment on City balconies have been most encouraging. Professor Northrup[1] has strongly advocated in America the formation of open-air roof wards.

All too slowly people are realizing that the artificial conditions of city life are far from providing the best influences for physical development, even of the innately vigorous. But to retain children with known tendencies to tuberculous disease within the sphere of urban influences when a country environment may be provided is to court disaster.

The sanatoria available for children in this country are at present all too few. Brief reference may be made to the more important.

The Royal Sea-Bathing Hospital at Margate, founded in 1791 by the celebrated Dr. Lettsom, claims with some justice to be the pioneer of British open-air institutions. Of its 150 beds, eighty-six are reserved for children. The cases treated comprise tuberculous disease of the joints—those of the spine and hip predominating—enlarged glands, and some cases of lupus.[2]

A small children's sanatorium has been established at Holt, in Norfolk, in connection with London's Invalid Children's Aid Association,[3] with accommodation for twelve little patients, Dr. F. W. Burton Fanning acting as honorary consulting physician (Fig. 24).

In connection with Dr. Barnardo's Girls' Village Homes at Barkingside[4] there is a compact little sanatorium with beds for sixteen children (Fig. 25).

[1] Northrup, W. P.: "Open-air Roof Wards on Metropolitan Hospitals" (illustrations given), *British Medical Journal*, October 26, 1907.

[2] An illustrated description by Mr. W. G. Sutcliffe, Honorary Surgeon to the Hospital, appears in "Special Number on Children" of the *British Journal of Tuberculosis*, p. 253, July, 1907.

[3] See description by the Hon. Secretary, Mr. T. H. Wyatt, M.V.O., in the *British Journal of Tuberculosis*, July, 1907.

[4] A description by Mr. William Baker, Hon. Director of Barnardo's Homes, appears in the *British Journal of Tuberculosis* for January, 1908.

FIG. 24.—THE CHILDREN'S SANATORIUM, HOLT, NORFOLK.

The Poor Children's Holiday Association at Newcastle-on-Tyne has recently established a sanatorium and farm at Stannington, in Northumberland[1] (Fig. 26).

[1] Dr. T. M. Allison, the hon. physician, gives a short description in the *British Medical Journal* for July, 1908.

FIG. 25.—SANATORIUM FOR CONSUMPTIVE CHILDREN AT DR. BARNARDO'S GIRLS' VILLAGE HOMES, BARKINGSIDE.

FIG. 26.—CHILDREN'S SANATORIUM, STANNINGTON, NORTHUMBERLAND.

The National Children's Home and Orphanage, which undertakes the care of nearly 2,000 little ones, and has twelve branches in different parts of the country, deals with a number of tuberculous cripples, and has made special provision for their open-air management (Fig. 27). A considerable proportion of the children are of consumptive parentage, and experience has shown that many of these in later life fall victims to tuberculosis. To secure the best possible conditions for successfully dealing with children of definitely tuberculous tendency a special country sanatorium is about to be established[1] (Fig. 28).

The Victoria Home for Invalid Children at Margate was established in 1892 for tuberculous children of the poor, and provides accommodation for forty-six cases.[2]

Reference should here be made to the seaside homes for tuberculous children provided by the Metropolitan Asylums Board. These are: St. Anne's Home, Herne Bay; East Cliff House, Margate; and Millfield, Rustington. The latter is intended for early cases of pulmonary tuberculosis.[3]

It may be hoped that Lord Mayor Treloar's Cripples' Home and College at Alton in Hampshire will soon provide another desirable institution for London's early tuberculous little ones.[4]

Wales has recently opened its first public sanatorium for adults at Allt-y-Mynydd, and it is very desirable that before long means should be forthcoming whereby a school sanatorium for Welsh children may be established in the Principality.

In Scotland very little has been provided in the way of sanatorium treatment for children.[5] The Bridge of Weir Sanatorium, in connection with the Orphan Homes established by the late William Quarrier, have set apart a small and separate building for children, with accommodation for about twenty cases.

Under the wise and courageous leadership of the Countess of Aberdeen a vigorous anti-tuberculosis campaign is being carried on in Ireland. As the work is being conducted under the auspices of the Women's National Health Association of Ireland, it is not likely that the special requirements of Irish little ones will be overlooked.[6]

[1] Full particulars of this promising scheme may be obtained on application to the Principal, the Rev. Dr. A. E. Gregory, at the Central London Offices, Bonner Road, N.E.

[2] For description see Dr. Bulstrode's report to the Local Government Board, "On Sanatoria for Consumption, and certain other Aspects of the Tuberculosis Question," p. 409. London, 1908.

[3] For reports of medical officers of the above homes, see "Annual Reports of the Metropolitan Asylums Board." Dr. Bulstrode, in his official report, gives descriptions of these homes and illustrations of East Cliff House and Millfield, *loc. cit.*, pp. 404, 484.

[4] Sir William Treloar gives a forecast of the work of this institution in the *British Journal of Tuberculosis* for July, 1907.

[5] Thomson, H. Hyslop: "The Protection of Children from Tuberculosis in Scotland," the *British Journal of Tuberculosis*, p. 204, July, 1907.

[6] See "Ireland's Crusade against Tuberculosis," vols. i. and ii. Edited by the Countess of Aberdeen. Dublin, 1908.

Hitherto the provinces and other parts of the kingdom have done but little towards providing adequate sanatoria for tuberculous

FIG. 27.—CHILDREN'S OPEN-AIR SHELTER AT CHIPPING NORTON HOSPITAL BRANCH OF THE NATIONAL CHILDREN'S HOME AND ORPHANAGE.

children. It is, of course, true that tuberculous infants and children are dealt with at the already existing children's and other hospitals, and many cases are sent to convalescent, country, and holiday homes;

but in nearly all these cases the relief afforded is but of a very temporary and often imperfect character.

Britain beyond the seas has apparently up to the present done little or nothing towards providing modern sanatoria for tuberculous children.

Tuberculosis dispensaries, after the pattern of those first organized by Calmette of Lille and Philip of Edinburgh, are being established in almost all civilized countries. It seems very desirable that in

FIG. 28.—PROPOSED SANATORIUM OF THE NATIONAL CHILDREN'S HOME AND ORPHANAGE FOR CHILDREN THREATENED WITH CONSUMPTION.

connection with these there should be formed special children's departments conducted by physicians and surgeons experienced in pediatrics. Parents attending the department for adults should be encouraged to bring their children for examination. According to Dr. Lowman,[1] "In the tuberculosis dispensary of Cleveland, Saturday afternoon is devoted to the examination of the children of families in which tuberculosis exists. Out of 500 examined, 20 per cent. show by physical signs, although the general condition of the child is good, that ganglio-tuberculosis exists."

[1] Lowman, John H.: "Tuberculosis and the Schools," *Charities and the Commons*, vol. xviii., p. 658. New York, 1907.

American Sanatoria for Tuberculous Children.

As far as can be ascertained, America, like Great Britain, has been slow to realize her responsibilities and opportunities in regard to the care of tuberculous children, and hesitant in making special provision for those tuberculously predisposed.

Dr. Livingston Farrand, the Executive Secretary of the National Association for the Study and Prevention of Tuberculosis in the United States, has placed at my disposal such information as appears to be available. According to his statement, "the special provision for tuberculous children in the United States is very slight"; but this is not likely to remain long the case, for "there are a number of Commissions investigating the question in different parts of the country. . . . This activity will result in a number of new foundations in the course of the next year or two."

It would seem as though the American tuberculous child, like its English tuberculous cousin, had in most cases, at all events, to be content with a place in an urban children's general hospital. It is inexplicable why the child-loving Anglo-Saxon peoples should have been so negligent of the needs of their tuberculous little ones.

The Sea-Breeze Experimental Seaside Hospital for Tuberculous Children at West Colney Island appears to be the chief of recent marine establishments in the United States. It is maintained by the New York Association for Improving the Condition of the Poor. It professes to be "the first American experiment in salt-air treatment of little children suffering from tuberculosis of the bones and glands. The purpose of the experiment is to attract the attention of American hospitals and American municipalities to the possibility of permanently curing little children afflicted with non-pulmonary tuberculosis."[1] This institution was established in 1904, and has beds for forty-five cases.

The New York State Hospital for the Care of Crippled and Deformed Children at West Haverstraw, New York, was instituted in 1900, and has thirty-two beds, which are restricted to cases of tuberculous diseases of joints and bones.

Stony Wold Sanatorium, at Lake Kushaqua, New York, caters for the need of consumptive working women and children. It has ninety-five beds, of which twenty-two are reserved for children.

The Montefiore Country Sanatorium, at Bedford Station, New York, a large Jewish institution, admits a few children, and has a well-equipped school in connection with it.

In the State of Massachusetts the Convalescent Home of the

[1] "New York Charities Directory." Published by the Charity Organization Society of the City of New York, 105, East 22nd Street. New York, 1907.

Children's Hospital at Wellesley Hills, established in 1903, has thirty beds and takes tuberculous cases.

In New Jersey, the Children's Sea-shore Home, Atlantic City, founded in 1872, has 375 beds, and of late years has devoted special attention to the requirements of tuberculous children.

In Ohio, a Children's Fresh-Air Camp has been established at Buckeye Road, Cleveland, with accommodation for twenty tuberculous children.

In Rhode Island, at Providence, a "Fresh-Air School" has recently been opened, where children predisposed to tuberculosis are being afforded educational facilities under fresh-air conditions. This experiment is arousing considerable attention and interest, and will doubtless be speedily followed by the establishment of similar schools throughout America.

There are, of course, in the United States, as in Great Britain, a number of seaside and country homes where doubtless a certain number of tuberculously crippled and delicate tuberculously disposed children are sent during the summer months.

In America also, as in this country, a certain number of sanatoria, primarily established for consumptive adults, admit a few tuberculous children. And, as Dr. Livingston Farrand says in the valuable communication he has sent me: "It must be remembered that practically all of the hospitals which deal with bone cases, either in children or adults, care for a large number of tuberculous patients."[1]

Continental Hospitals and Sanatoria for Tuberculous Children.

To France belongs the honour of being the leader in providing marine and other sanatoria for tuberculous children. She has justly won world-wide distinction in the protection of infancy and childhood, and, as Professor Calmette and Dr. Breton have shown in this

[1] In addition to the information given in this volume the reader may be referred to Dr. S. A. Knopf's article on "The Preservation of Children and Adults from Tuberculosis in America: Historical Review of the Anti-Tuberculosis Movement in the United States," *British Journal of Tuberculosis*, vol. i., p. 193, July, 1907. Useful references may also be obtained in "A List of American Societies and Committees for the Prevention of Tuberculosis, and State Commissions up to January 1, 1905," reprinted from Dr. S. A. Knopf's article on "The Present Status of the Anti-Tuberculosis Work in the United States," *Journal of American Medical Association*, February 11, 1905; and in "Consumption: its Relation to Man and his Civilization," by John Bessner Huber, A.M., M.D. Philadelphia and London, 1906. See also: "A Directory of Institutions and Societies dealing with Tuberculosis in the United States and Canada," compiled by Lilian Brandt. New York: Charity Organization Society, and National Association for the Study and Prevention of Tuberculosis. 1904. A new edition of this valuable Directory, we understand, is in preparation.

volume, to her is due the chief credit of having shown the world how it may best care for its tuberculous little ones.[1]

Germany, ever systematic and scientific in its elucidation of medico-sociological problems and eminently practical in its constructive methods, has during the last few years nobly won the foremost place among the nations who are seriously attempting to make the best of their children. Germany has invented the forest-school, as is so fully indicated in the article by Professor Nietner, and these admirable institutions are not only spreading throughout the Fatherland, but are being imitated in Great Britain, America, and other lands.[2] Dr. Nietner has kindly favoured us with a list of German institutions now actively engaged in caring for tuberculously inclined cases, but it is so extensive that we regret that it is impossible to do more than refer to the original publication.[3]

Denmark has accomplished much for tuberculous children. Sea-side homes for so-called scrofulous cases have existed for more than thirty years. There are now five marine stations for children: Refsnaes, Snogebaek, Hellebaek, Odder, and Juelsminde. There are also two convalescent homes, where some tuberculous cases may be admitted. Many young subjects are treated for lupus at the far-famed Finsen Light Institute at Copenhagen. Several excellent societies exist which devote much attention to the care of tuberculous children.[4]

Belgium possesses marine stations at Middel Kerke, Venduyne, and Ostende, and an inland home at Esneux where children threatened with tuberculosis are sent.

Russia, according to Dr. Rufenacht Walters, has "a number of convalescent homes for children, not specially for tuberculosis, including one under Dr. Bohl at Oranienbaum (thirty-five beds), and one at Arensburg (sixty beds, Dr. W. Arnd). A sanatorium for consumptive children is projected at Sestrorezk by the Sisters of the Red Cross (twenty beds)."

[1] Dr. Fernand Barbary, in his valuable study of "The Anti-Tuberculosis Movement in France," in the *British Journal of Tuberculosis*, vol. ii., No. 2, p. 100, April, 1908, gives particularly helpful tables of Sanatoria, Marine Stations, Climatic and Thermal Resorts for Children. Dr. Rufenacht Walters, in his work on "Sanatoria for Consumptives," third edition, London, 1905, devotes a chapter, with illustrations, to "French Sanatoria for Children and Adolescents." A useful article on some of the French Marine Sanatoria for Children appeared in the *British Medical Journal*, June 11, 1904. See also "Le Sanatorium de Saint Pol-sur-Mer," par A. Vallet, Lille, 1906; and "L'Œuvre de l'Assistance publique Contre la Tuberculose: Paris, Administrative Générale de l'Assistance publique à Paris," 1905.

[2] See also Baginsky, A.: "Measures employed in Germany for the Prevention and Treatment of Tuberculosis in Children," *British Journal of Tuberculosis*, vol. i., p. 197, July, 1907.

[3] "Dei deutschen Heilstätten für Lungenkranke im Frühjahr 1908," in "Der Stand der Tuberkulose-Bekämpfung im Frühjahr 1908." Berlin, 1908.

[4] Rφrdam, H.: "Institutions Danoises pour le Traitement de la Tuberculose." Copenhagen, 1907. Also publications of "National foreningen til Tuberkulosens Bekæmpelse," 22, Citygade, Copenhagen.

Switzerland, Norway and Sweden, as indicated in the special articles contributed to this work, are each accomplishing much for the prevention and arrest of tuberculosis among their children.

Even Turkey is making provision for the open-air treatment of her tuberculous little ones.[1]

The Construction and Management of Sanatoria for Children.

Much has been written regarding the designing, construction, and equipment of sanatoria for adults,[2] but comparatively little has been published as to the special requirements of sanatoria for tuberculous children. Those of us who have had personal experience of treating tuberculous children in sanatoria designed and conducted for adults know well the serious drawbacks of this association. As Dr. Arthur Latham[3] says: "Children usually interfere with the necessary discipline, and require special arrangements for their education; further, they make greater and more rapid progress, according to our experience, when treated in an establishment specially set apart for them."

In this and other countries it has been the custom with not a few sanatoria primarily intended for adults to admit a certain proportion of children. This is an arrangement which on all grounds is to be deprecated. Just as sanatoria for adults should be as far as possible work-sanatoria, so for children it is essential, if the best is to be done, that the establishments for them should be of the nature of school-sanatoria.

Within the necessary limitation of a work such as this it is not possible to discuss the architectural features, structural details, and minutiæ of equipment of sanatoria for tuberculous children. Even to attempt such would be undesirable, for at the present time there should be very considerable opportunity for freedom in design and variety in construction, and, we may add, liberty in manner of management. It would be little less than calamitous if a stereotyped model and method were to be adopted. Individual needs and local requirements, as well as the important matter of ways and means, must all receive full consideration.[4]

[1] See illustration of open-air gallery for tuberculous children at the Hamidié Hospital at Constantinople in *British Medical Journal*, p. 880, April 11, 1908.

[2] A valuable Bibliography is given by Dr. Arthur Latham and Mr. A. William West in their "Prize Essay on the Erection of a Sanatorium for the Treatment of Tuberculosis in England." London, 1903. See also Ransome, A.: "The Principles of Open-air Treatment of Phthisis and of Sanatorium Construction." London, 1903.

[3] Latham, A., and West, A. W.: "Prize Essay on the Erection of a Sanatorium for the Treatment of Tuberculosis in England," p. 68. London, 1908.

[4] The practical worker may be referred to a discussion on "The Construction of Sanatoria" in the *British Journal of Tuberculosis*, October, 1907; and particularly to the following: Holman, G. E.: "Sanatoria for Children"; and Plumbe, R.: "The Flooring of Sanatoria."

It is well, however, that certain general principles should be clearly borne in mind. Let it be said at once that no countenance should be given to structures which are manifestly extravagant to construct and expensive to maintain. For children the institutional system should as far as possible be avoided. Hygienic and artistic simplicity combined with requisites for efficiency in working must be secured. A good sanatorium for children should provide the atmosphere of home life as well as something of the spirit of a school, and yet possess the essential points of a hospital. To attain this mere cheap, haphazard, ephemeral buildings, such as some enthusiasts, having apparently only experience of summer weather and vigorous health, are so fond of advocating, will never do.

For "preventoria," prevention sanatoria for the comparatively healthy but predisposed tuberculous child, and for summer colonies, forest schools, and the like, a comparatively inexpensive type of building answers admirably. But for definitely tuberculous cases, children who may be bed-fast for months with active disease of bones and joints, or deep-seated tuberculous involvement of lungs or other organs, hospital equipment, however homely in appearance, must be provided. For these all-the-year-round cases there must be an adequate administrative base, with proper arrangements for medical and nursing staff, and efficient means for lighting, warming, washing, and the like. For some classes of cases an operative theatre with X-ray equipment and properly fitted laboratory are essential. Necessarily all this means money. If the tuberculous child is to be dealt with fairly, the nation must be willing to provide what is needful to secure the best results.

For the proper management of sanatoria for children special gifts and graces are required. The nurse who undertakes this kind of work must be a lover of child life. She must understand something of the psychology of childhood, as well as know the principles of normal and morbid physiology, and be well practised in the art of nursing. She should also have the knack of imparting knowledge in an acceptable and attractive manner, for the nurse must also play the part of teacher. With the growth of sanatoria for children there should be a new opening for a high-class type of woman, the nurse-teacher. Such work might well provide a field for many arrested cases of tuberculosis.

Brief reference must be made to seaside sanatoria for tuberculous children. In countries like the British Isles, Denmark, France, Norway, and Sweden, having an extensive seaboard, with much-frequented health-resorts, it was but natural that marine sanatoria should have come into existence. For long they were considered essential for the best management of tuberculous children, and no

doubt for certain cases, especially where the disease involves bones, joints, and glands, seaside stations offer advantages. The opinion seems to be growing that the advantages do not outweigh the very distinct disadvantages. Certainly quite as good results are to be obtained at suitable inland stations. This is fortunate, for it would be very difficult for some districts—as, for example, certain States of America—to provide marine sanatoria. Sir Hermann Weber,[1] at the London Congress on Tuberculosis, advocated the formation of an "Association for the Erection of Seaside Sanatoria," as a subdivision of the "National Association for the Prevention of Consumption and other forms of Tuberculosis."

For pulmonary and laryngeal cases the sea-coast is generally unfavourable. Dr. William Ewart,[2] in discussing this subject of marine climatic stations for tuberculous cases, very wisely says: "Their powers for prevention are vastly in advance of their powers for cure. Prevention is *par excellence* the use to which they should be put, and this is also the steadily growing tendency of the sanatorium movement in this country. The place for the 'prevention-sanatorium,' or 'preventorium,' is the sea-coast."

The Co-ordination and Co-operation of Anti-Tuberculosis Efforts in the Interests of Infancy and Childhood.

The anti-tuberculosis movement, perhaps above all others, calls for co-ordination and co-operation. It is only by the ordered combination of the efforts of voluntary and official workers that real advance can be made. In every country there should be a National Tuberculosis Bureau. International action might then be rendered possible. For lack of knowledge and opportunity the people perish and the children suffer. At present we are in the experimental stage of reform. Dr. Newsholme, in his recently published luminous work on tuberculosis, has indicated a scheme whereby the present scattered efforts and enterprises *in posse*, as well as *in esse*, might be brought into active relationship one with another. Much may and should be done by scientifically directed voluntary associations and individual philanthropic enterprise, but it is becoming abundantly manifest that "the State, whether from paternal imperial motives, or on account of the modified socialistic tendencies of modern times, ought to undertake the direction of the forces, and assume all the responsibility connected with leadership."[3]

[1] Weber, Sir Hermann: "A Plea for Seaside Sanatoria for Children, especially for the Prevention and Treatment of Scrofulous Complaints," Transactions of the British Congress on Tuberculosis, vol. iii., p. 234. London, 1902.

[2] Ewart, W.: "The Present Position of the Treatment of Tuberculosis by Marine Climates," the *Journal of Balneology and Climatology*, July, 1907; also "Marine Climates in the Treatment of Tuberculosis," London, 1907.

[3] Weber, Sir Hermann, and Weber, F. Parkes: "Climato-therapy and Balneotherapy," p. 630. London, 1907.

To wage successful warfare with tuberculosis it is essential to take the widest possible outlook. "To become tuberculous, an individual must not only be infected by the *Bacillus tuberculosis*, but at the time of infection must present somewhere in his body a suitable soil for the propagation of the organism."[1]

Fischl[2] also well expresses it: "The fight against tuberculosis is not only to be waged against the infection, but also against the tuberculous disposition, and to insure success must include hygienic rules for the bringing up of children and for diet."

A restricted view with regard to tuberculosis means serious limitation of effort. As Sir Richard Douglas Powell has so well expressed it: "The prevention of consumption involves a much wider issue than the circumvention of the bacillus. . . . The abolition of the Corn Duties and other Free Trade legislation, and improved rates of wages, have done more than any notification law against the disease would have been likely to have effected."[3] All that tends to human betterment may well be welcomed as making also for conditions under which anti-tuberculosis measures may be more effectively conducted.

One word must be said respecting notification. It is certainly most desirable in the interests of the family and the nation that tuberculous individuals should be known to the medical officer of the district in which they reside. Unfortunately, at present his powers to help such cases are miserably meagre. For the sake of protecting the children, some form of notification would seem highly desirable. But there are at present many difficulties in the way. With regard to the much-discussed question of compulsory notification, Dr. Newsholme's opinion deserves careful consideration, particularly as coming from the Chief Medical Officer of the Local Government Board. As it admirably expresses the views of some of our most able administrators and reliable leaders in the anti-tuberculosis movement, it may well be quoted here: "At present it would be inexpedient, unwise, and of relatively little use to advise the general adoption of compulsory notification of phthisis. Public opinion is not ripe for this step, and such notification would remain to a large extent a dead letter. Local authorities are not ready to utilize the information thus received, *to the benefit of the patient and of the public*. I place the two together, because they are substantially identical. It would, in my opinion, be premature for any community to adopt compulsory noti-

[1] Ashby, H., and Wright, G. A.: "The Diseases of Children," p. 245. Fifth edition. London, 1905.

[2] Fischl, R.: "The Prevention of the Diseases of Children" in "The Prevention of Disease," p. 447. English edition. Edited by Dr. H. T. Bulstrode. London, 1902.

[3] Powell, Sir R. Douglas: "Lecture on the Prevention of Consumption," *Journal Sanitary Institute*, vol. xxv., Part II., p. 353. 1904. Quoted by Dr. Newsholme in "The Prevention of Tuberculosis," p. 230. London, 1908.

fication of phthisis which (*a*) does not possess a sufficient staff of skilled visitors, preferably medical men or women, to visit the notified cases; and (*b*) does not possess sanatorium beds available for the treatment and training of consumptive patients. Under these circumstances, compulsory notification can be made to work, even in the present state of public opinion, to the benefit of all concerned; without such aid, I do not say that considerable good will not be done, but that the good done probably will not so far exceed that capable of being done under a voluntary system as to justify in most districts the addition at present of the element of compulsion."[1]

It seems likely that with the coming of medical inspection in public schools, the establishment of school clinics, and visitation of the scholars' homes by the school-nurse, much of what compulsory notification aims to secure may be quietly attained.

The milk question affords another perplexity intimately bound up with the tuberculosis problem. It is in many ways extremely involved and surrounded by difficulties. As is clearly indicated in this volume, some regard tuberculously contaminated milk as the most fruitful source of infection in infancy and childhood. Others contend, with Koch, that its influence in spreading tuberculosis is insignificant. It has been stated that about 30 per cent. of the cattle in English cow-houses are diseased. According to Dr. H. E. Armstrong,[2] "In the year 1901 there were 1,887,414 milch cows in England and 4,102,061 in the United Kingdom. Thirty per cent. of these means upwards of 560,000 tuberculous milch cows for England alone, and nearly 1,250,000 for the United Kingdom." If tuberculous milk is as virulent as so many declare, it is difficult to conceive how any infants and children escape infection.

Whatever opinions may be held as to the importance of milk as a medium for the spread of tuberculosis, all may well unite in practical endeavour to secure a pure milk-supply.[3]

One word should here be added on the difficult problem relating to tuberculosis and marriage and offspring. This complex question has been fully discussed by Kaminer.[4] His conclusions are so reason-

[1] Newsholme, A.: "The Prevention of Tuberculosis," p. 349. London, 1908.

[2] Armstrong, H. E.: "Tuberculosis: its Casualties, Causes, and Control." Newcastle-upon-Tyne, 1907.

[3] See in relation to this matter:
Swithinbank and Newman: "Bacteriology of Milk." London, 1903.
Dodd, F. L.: "The Problem of the Milk-Supply." London, 1904.
McCleary, G. F.: "Infantile Mortality and Infants' Milk Depôts." London, 1905.
Spargo, J.: "The Common-Sense of the Milk Question." New York, 1908.
Also: Penberthy, J.: "The Veterinary Aspect of the Tuberculosis Problem," the *Journal of Comparative Pathology and Therapeutics*, vol. xx., No. 4, December, 1907.

[4] Kaminer, S.: In "Health and Disease in Relation to Marriage and the Married State," vol. i., p. 363. New York and London, 1904.

able that they may well be quoted as affording a safe guide for action: "In permitting tuberculous individuals to marry, it is necessary to follow certain fixed principles with regard to the different classes of the disease, and also with regard to individual cases. If we take the advantages of marriage of tuberculous people on the whole, and compare them with the disadvantages and dangers, the latter no doubt preponderate over the former. If it is, therefore, necessary as a rule to oppose the marriage of tuberculously affected individuals with far more energy than that of persons only hereditarily predisposed to tuberculosis, it is, nevertheless, in view of what has been said above, an established fact that circumstances may occasionally arise where the advantages of marriage outweigh the disadvantages, where there is either no danger at all involved by marriage, or where, if present, such danger may be materially diminished by suitable prophylactic or therapeutic measures."

Tuberculosis cannot be satisfactorily studied apart from the other social problems which await solution. Either as cause or effect, and sometimes as both, it is closely associated with many of the ills which afflict the people. Poverty and its inevitable consequences are intimately related to tuberculosis. Hygienic sins and ignorances in the individual, insanitary conditions in the home, and lack of healthy environment generally, must each and all be faced if tuberculosis is to be annihilated. It is well to remember that as a rule the results of poverty, insanitation, bad housing, malnutrition, and the other morbid conditions of life which predispose to tuberculosis and other diseases, press most heavily and act most detrimentally on the women and children.[1]

The wife and family of the consumptive worker often suffer disastrously. Prolonged illness quickly brings dire poverty, with the unavoidable consequences of comparative starvation and insanitary housing. These and other physical disabilities, with sorrow and anxiety, pave the way for an easy access of the tuberculous foe to each member of the home. Until some such system of insurance against sickness and invalidity as that so successfully adopted in Germany is available for the British workman, it would seem as though the extermination of tuberculosis must be long deferred.[2]

[1] See such works as:
Newman, G.: "Infant Mortality." London, 1906.
Rowntree, B. S.: "Poverty: a Study of Town Life." Fourth edition. London, 1902.
Booth, Charles: "Life and Labour of the People in London." London, 1902.
Also: "Report and Minutes of Evidence of Inter-Departmental Committee Report on Physical Deterioration." London, 1904.
"Report on the Physical Condition of Fourteen Hundred School-Children in the City of Edinburgh." London, 1906.

[2] For full discussion of this subject, with bibliographical references, see article in Dr. H. T. Bulstrode's valuable Report to the Local Government Board: "On

In France, under the influence of Grancher, attempts have been made to remove apparently healthy children from the intimate association of life in the homes of their tuberculous parents. In England efforts have been more directed to the removal of the tuberculous subject from the home. There is wisdom in both courses, but every case requires individual consideration.

The experiment so successfully conducted in Stockholm[1] of providing homes under medical supervision, and where the services of a skilled nurse are also available, for arrested or comparatively inactive cases of consumption occurring in working men with families, might well be tried in other centres of industry.

The cause of the children is being served by many societies and associations in this country, and by such valuable organizations in Germany as infant "Fürsorgestellen" and in France as the "Goutte de Lait."

The "Schools for Mothers" which seem likely to spread in this country should become valuable accessories in the anti-tuberculosis movement.[2]

All bodies seeking to secure a high standard of national health should place the protection of infancy and childhood in the very forefront of their programme. It is only by instruction of the people in all ranks of society that success may be secured.

America, with characteristic ingenuity and resource, is discovering many valuable new weapons by which the combat may be more effectively waged against tuberculosis.

The establishment of classes for the instruction of consumptives is a particularly admirable and common-sense measure. At least one such class has been formed for children.

Special reference should be made to the prevalence of alcoholism, which both directly and indirectly favours the development and spread of tuberculosis. The opinion expressed at the London Congress on Tuberculosis still holds good: "Such evidence as is forthcoming appears to furnish strong ground for the belief that measures aiming at the extermination of tuberculosis should also include means for the suppression of alcoholism."[3]

Sanatoria for Consumption and certain other Aspects of the Tuberculosis Question." London, 1908. Consult also "Reports of the Proceedings of the National Conferences on Infantile Mortality." London, 1906 and 1908.

[1] Buhre, B.: "The Crusade against Tuberculosis in Sweden," *British Journal of Tuberculosis*, April, 1908.

[2] "A School for Mothers." By Evelyn M. Bunting, Dora E. L. Bunting, M.B., B.S., Annie E. Barnes, and Blanche Gardiner, B.A. With an Introduction by Sir Thomas Barlow, Bart., K.C.V.O., M.D., and a chapter by Dr. J. F. J. Sykes. London, 1907.

[3] Kelynack, T. N.: "The Relation of Alcoholism to Tuberculosis," Transactions of the British Congress on Tuberculosis, vol. iii., p. 334. London, 1902.

The late Professor Brouardel, of Paris, at the same Congress declared that "Alcoholism is, in fact, the most powerful factor in the propagation of tuberculosis." Landouzy summarizes the relationship thus: "L'alcoölisme fait le lit de la tuberculose." Among those engaged in the sale of alcoholic drinks, as well as among those who indulge freely in the same, tuberculosis is very prevalent. Dr. Sidney Davies, of Woolwich, Dr. James Niven, of Manchester, Dr. Arthur Ransome, and others, have called attention to the public-house as definite source of tuberculous infection. Now that it is known that women and children frequent these places in very large numbers, it is most desirable that steps should be taken to meet this difficulty and arrest this danger.[1]

An unbiassed consideration of the case seems to abundantly justify the following resolution adopted at the last International Congress on Tuberculosis at Paris in 1905: "That in view of the close connection between alcoholism and tuberculosis, this Congress strongly emphasizes the importance of combining the fight against tuberculosis with the struggle against alcoholism."

A careful study of the various sections of this work shows that, however widely views may differ as to pathological considerations and the interpretation of experimental inquiries, all may unite in the conduct of a practical campaign to safeguard the coming race from tuberculous invasion. No anti-tuberculosis movement can hope to attain any full measure of success if it is content to subordinate the care of the children to a second place. In the carrying out of a wise anti-tuberculosis policy, the protection of infancy and childhood must be the first duty. To fulfil this most responsible and heavy task individual effort must be supplemented and completed by national action. As a means to this end, every country should form, and if possible in intimate association with already existing anti-tuberculosis organizations, a National Society for the Study, Protection, and Treatment of Tuberculous Children.

[1] See Home Office Return, "Women and Children in Public-houses," London, 1907; and articles in "The Drink Problem," London, 1907.

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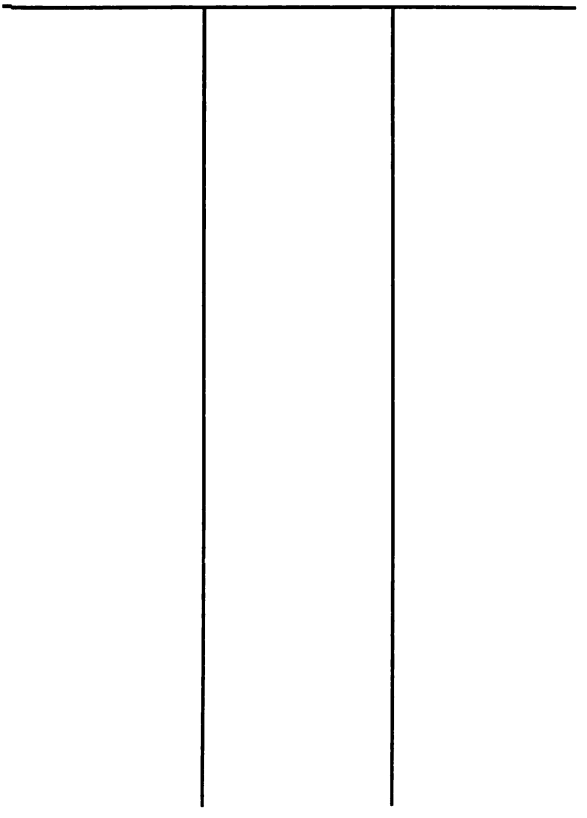

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